TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

ANTTI REKOLA

CREATING A DISTRIBUTION MODEL IN THE RUSSIAN MARKET

Master's Thesis

Examiner: prof. Jarkko Rantala
Examiner and topic approved by the Faculty Council of the Faculty of Business and Built Environment on 3 April 2013

TIIVISTELMÄ

TAMPEREEN TEKNILLINEN YLIOPISTO
Tuotantotalouden koulutusohjelma

REKOLA, ANTTI: Creating a distribution model in the Russian market
Diplomityö, 104 sivua
Elokuu 2013
Pääaine: Logistiikka ja kuljetusjärjestelmät
Tarkastaja: professori Jarkko Rantala
Avainsanat: Jakelumalli, kansainvälistyminen, rakennusteollisuus, sijaintien keskipiste, toimitusketjun hallinta, Venäjä

Työssä kehitetään kohdeyritykselle jakelumalli Venäjän markkinoille. Nykyisin yritys maahantuo koko tarjoomansa, mutta tulevaisuudessa valtaosa volyymista valmistetaan Tatarstaniin vuonna 2015 avattavassa tehtaassa. Työ keskittyy jakelukeskusten sijaintiin asiakkaiden kannalta, mutta siinä arvioidaan myös kysynnän kehittymistä sekä tukkureiden roolia tulevaisuudessa kohdeyrityksen ja loppuasiakkaiden välillä.

Työn aineisto alkaa Venäjän markkinoita käsittelevien kvalitatiivisten tutkimusten käsittelyllä. Niiden tueksi sovelletaan käytännössä sijaintien keskipisteitä (centers of gravity) ja muita geometriaan pohjautuvia työkaluja ihanteellisten sijaintien löytämiseksi jakelukeskuksille. Osittain iteratiivisesti kehitetään kaksi vaihtoehtoa kohdeyrityksen jakeluhypoteesille. Näitä kolmea verrataan toisiinsa sijaintien, kuljetusmuodon, kustannusten, toimitusaikojen, riskien ja herkkyysanalyysin pohjalta.

Tulokset osoittavat, että kohdeyrityksen potentiaalinen kysyntä on epätasaisesti jakautunutta Venäjällä, mutta todellinen myynti on vielä epätasaisempaa: yli puolet myynnistä kohdistuu kolmelle moskovalaiselle tukkurille. Ulkoisen väestöllisen datan ja kohdeyrityksen todellisten myyntilukujen perusteella todetaan, että tuotantolaitoksen sijainti Tatarstanissa on ihanteellinen myös jakelukeskukselle, jos Venäjälle lasketaan vain yksi keskipiste. Jos määritetään erilliset keskipisteet Euroopan puoleiselle ja Aasian puoleiselle Venäjälle, Moskova ja Tšeljabinsk ovat soveliaimmat sijainnit.

Toimintasuositus on jakelukeskusten avaaminen Moskovaan ja Tšeljabinskiin. Tämä vaihtoehto mahdollistaa väliportaiden ohittamisen jakeluketjussa ja suorat kontaktit loppuasiakkaisiin. Toimintasuositus on vaihtoehdoista asiakaspalvelulähtöisin ja strategisesti kauaskantoisin. Maahantuodut tuotteet kulkevat edelleen Pietarin kautta laivalla, mutta kuljetukset Venäjällä suoritetaan teitse. Rautatiet ovat mahdollinen kuljetusmuoto valmistuksen ja jakelukeskusten välillä. Asteittainen kehitys on mahdollista, sillä jakelu voidaan järjestää ensin vain Moskovan kautta, ja Tšeljabinskin jakelukeskus voidaan lisätä myöhemmin. Toimintasuositus perustuu palvelutason painottamiseen, mutta toisenlaisilla painotuksilla yrityksen esittämä jakeluhypoteesi (jakelukeskukset Pietarissa ja Tatarstanissa) on myös kelvollinen ratkaisu.

Tuloksia rajoittaa tiedon saatavuus ja hidasteet tutkimusprosessissa. Tulevaisuudessa kohdeyrityksen tulisi kehittää ratkaisunsa toteuttamiskelpoiseksi suunnitelmaksi ja tutkia Venäjän markkinoiden kehittymistä laajemmin. Yleisen tutkimuksen tulisi arvioida sijaintien keskipisteiden soveltamista sijaintipäätöksissä ja ulkoisen väestöllisen datan käyttöä loppuasiakkaiden kysynnän jakauman arviointiin.

ABSTRACT

TAMPERE UNIVERSITY OF TECHNOLOGY
Degree Programme in Industrial Engineering and Management

REKOLA, ANTTI: Creating a distribution model in the Russian market
Master of Science Thesis, 104 pages
August 2013
Major: Logistics and transportation systems
Examiner: Professor Jarkko Rantala
Keywords: Center of gravity, construction industry, distribution model, internationalization, Russian market, supply chain management

The thesis is written to provide the focal company with a distribution model in the Russian market in a changed manufacturing situation: the company has thus far imported its goods to Russia and is starting local manufacturing in Tatarstan in 2015. The thesis focuses on the locations of distribution centers (DCs) in relation to the geographical distribution of actual and potential customers. Also, it assesses future demand and the role of intermediaries between the company and its end-customers.

The materials used for the thesis start with reviewing qualitative research on the Russian market, which is then supplemented by the pragmatic application of centers of gravity and other geometrics-based tools to find optimal locations for DCs. The process being iterative, two alternatives for the base case proposed by the focal company are developed. All three scenarios are assessed based on location optimization, mode of transportation, logistics costs, lead times, risks and sensitivity analysis.

The results indicate that the potential distribution of end-customer demand is highly uneven, but not as uneven as the actual sales distribution of the company, over half of which are to three Moscow-based distributors. Based on demographic and sales data, the location of the new plant in Tatarstan is found to be an ideal location for a DC when only one center of gravity is calculated. When centers for European and Asian Russia are calculated, Moscow and Chelyabinsk are the most suitable locations.

The recommendation is to open DCs in Moscow and Chelyabinsk accommodating the possibility for direct contacts to end-customers. This is the most customer-oriented and strategically far-sighted option. Imports still enter Russia through Saint Petersburg by ship, but transportation within Russia happens by road. Trains are a possibility between manufacturing and DCs. The progression can be gradual, since the DC in Moscow is capable of serving all of Russia, while the Chelyabinsk DC can be added later. This proposal is based on high service level prioritization, and arguments for the base case (Tatarstan and Saint Petersburg DCs) can be made too.

The results of the research are limited by the availability of data and other hindrances in the project. In the future, the company should develop their solution to an executable plan and further investigate the Russian business environment. Research in general should examine the application of centers of gravity to similar decision making and the use of external, demographic data to approximate end-customer demand.

PREFACE

This thesis was commissioned by Containerships Ltd Oy as a business development project for one of their client companies, and it was written during the first half of the year 2013. I thank Professor Jarkko Rantala for his advice and quick responses – and Professor Jorma Mäntynen for recommending this great project for me and me for this great project. Also, I thank Kari-Pekka Laaksonen, Juha-Pekka Mäkelä, Ala Suslova, Jari Vainio, Anita Virtanen and everyone else at Containerships and at the focal company who helped me during the writing process.

June 18, 2013

Antti Rekola

CONTENTS

TERMS AND DEFINITIONS

Circuity factor	A factor by which great circle distances are multiplied to approximate the actual road distance between two points.
CIS	The Commonwealth of Independent States. A regional organization formed by former Soviet Republics. Current official members are Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan and Uzbekistan – de facto also Turkmenistan and Ukraine.
Company X	The focal company whose name has been disguised for the thesis.
Company X Ceilings	The focal business unit of Company X.
DC	Distribution center. A type of warehouse where the storage of goods is limited or non-existent.
Ex works	Sales arrangement where the seller makes the goods available at its premises, ergo the customer has to arrange transportation for them.
GRP	Gross regional product. A measure for the size of a region's economy. The market value of all final goods and services produced there over a period of time.
HDI	Human development index. A composite statistic of life expectancy, education and income indices to estimate human development.
SKU	Stock-keeping unit. A product offered by a company.
Tatarstan	The location where Company X is building a production plant. The exact location is not mentioned in this thesis.
Yanino	A logistics park in Saint Petersburg. Currently all Company X products are imported to Russia and pass through Yanino.

1. INTRODUCTION

1.1. Motivation

Russia is the largest country in the world and arguably one of the countries that has withstood the greatest turmoil over the past decades. After the fall of the Soviet Union, Russia has seen both highs and lows, and Company X, a global manufacturer of floors and ceilings, has been operating in the market for most of this time. It entered the Russian suspended ceiling market already in 1992, and, after 20 years of careful progression, the company is starting local manufacturing.

Russia is an immense growth opportunity for many western companies, and Company X is no exception, as Russia – among other developing markets like China – is a cornerstone in its growth strategy. Historically, the company has gained most of its revenues through the U.S. market, but as the world grows smaller, the significance of markets like Russia increases. This, of course, would have been unheard of during the Soviet era. Since Company X's market share, the suspended ceiling market, the construction industry and the entire Russian economy still live in a period of unsettled transformation, the future holds great potential – and possibly great risks.

This thesis is written to provide a distribution model for Company X in Russia. The company is building a mineral fiber ceiling plant in Tatarstan 800km east of Moscow, and the plant will be operational in 2015. This puts Company X in a completely new situation, as all products are currently imported to Russia through Saint Petersburg. In the new situation, some 80% of product volume will be produced in Tatarstan and the rest will be imported. This demands a new distribution model, as selling is simultaneously moving from ex works towards delivering the products to distributors.

The investment in the Tatarstan plant is substantial, $100 million, and, considering Russia's role as a strategic growth opportunity for Company X, a closer inspection of distribution possibilities needs no further justification. The construction of the plant is under way, and the goods will need to be distributed eventually.

The scientific value of this thesis is in its application to Russia. The Russian market, as many other growing markets, is significantly different from Western markets with regard to infrastructure, growth, bureaucracy and corruption, for example. It is a market where risk-avoidance is nearly impossible, and the greater the risks are, the greater profit they may yield. Research on the Russian market has been made internationally and especially in Finland since the collapse of the Soviet Union, but the society and the economy at large are under constant change. As such, business models that were functional twenty years ago may be utterly outdated in 2013. Also, this thesis is an attempt to apply fundamental distribution-related concepts to a market that is nothing short of chaotic. Amendments have to be made to suit Russia – which is visible even in Company X's careful gradual progression there as oppose to other countries – and they affect the equation as well.

1.2. Research problem and research questions

The research problem is to examine different distribution alternatives for Company X in Russia after the Tatarstan plant is operational. The main research question is:

> ***How should Company X's products be transported to distributors in the changed production and importing situation?***

This main research question is divided to further subquestions, which help conceptualize and answer the main question, but their fulfillment is not an end in itself. These questions include:

> *How many distribution centers should Company X operate and where? What are their specifications?*
>
> *How will Company X's demand develop in the future?*
>
> *What is the role of intermediaries in the future? Will their significance wither or grow?*

The questions concerning distribution centers *will* be answered as that is a main factor in the proposed distribution model. Future development of demand deserves also consideration, since the distribution model should, of course, fit the demand. If the model developed is optimized only for the current or historic demand, it may be irresponsive to demand development and become outdated and obsolete over the years. The role of intermediaries is also something to bear in mind, since their significance tends to wither in a foreign market over time as a company gains more market knowledge and develops direct contacts to its customers. Naturally, eliminating intermediaries means cost savings, if their services bring no added value to the company. However, in an unpredictable environment like Russia, the role of intermediaries, who are natives or at least specialists on the market, may be crucial to the survival of the company, and their added value may be higher than expected.

The subquestions will not be fully addressed in this thesis as its scope does not fit the extent of variables and depth required to examine all of these issues in detail. Thus they are included in the narrative, but deeper analysis on them is left for future research.

1.3. Methodology, point of view and restrictions

This thesis is performed as a pragmatic, constructive study. The situation at hand is one that is based in real life, and as such, pragmatism and an applied point of view are more justified than strict adherence to one theoretical approach. Different distribution alternatives will be created and compared to solve the research problem. The fundamental concepts of these alternatives were proposed by a representative of Company X: The base case proposed is to have a commodity distribution center near the plant in Tatarstan and a non-commodity distribution center at the current location in Saint Petersburg. Other alternatives include having only one distribution center and conversely having two or more of them at other locations in Russia. These alternatives are not necessarily *mutually exclusive and collectively exhaustive*, but they are a rational and manageable set of alternatives that can be addressed within the scope of this thesis.

The criteria used for creating and comparing the alternatives are both qualitative and quantitative. The quantitative criteria include the logistics costs of the alternatives and calculations for the center of gravity and other demand-derived location parameters. The qualitative criteria include consideration to service level (lead times and reliability) and risks related to each alternative. The alternatives are then examined through sensitivity analysis with regard to changes in demand, for example.

Restrictions are mostly due to Company X's global experiences and strategy: The goal is to transport full truckloads with as little offloading and reloading as possible due to the fragility of the product and its low value-to-size. Company X also wants to provide best lead times and best availability, and it differentiates its offering from competitors with a service element. Another key limitation is that Company X itself will not own any vehicles since the actual transportation will be performed by outside haulers. Company X's strategy in Russia, as will be discussed later on in the thesis, relies on gradual step-by-step progression, and this risk-avoidance is also a restriction that will be considered. Thus the thesis is bound by these restrictions and Company X's gradual progression in Russia. They dictate the extent to which different can be created.

A restriction on the language used in this thesis is that the name of the focal company is disguised and it is only referred to as Company X. A result of this, the list of references at the end of the thesis contains a separate list of "confidential sources", as naming them would reveal the name of the focal company. Those sources are, however, publically available; confidentiality only means that their names and authorship are left out. The exact location of the new production plant is also unmentioned as per request from Company X, and it is called the Tatarstan plant in the thesis.

The most significant restriction to this thesis is, however, the fact that the data used in this thesis had to be derived from Containerships (the company in charge of transporting

Company X goods to Russia) and public sources instead of Company X itself. Whether or not confidential data from Company X would be available was uncertain throughout the most part of the writing process of this thesis, and as such, the exact methodology and possibilities explored could not be defined at the beginning of the writing process. Thus much of the research papers and data used come from sources that address matters on a more general level, and their direct applicability to Company X is not always as straightforward as would be if materials had been available, or even if their unavailability had been known earlier in the process.

Also, the unavailability of data and the postponement of the decision to get access to it leave the results of this thesis rather superficial. Different parameters to assess alternatives for a distribution solution are presented, but some are applied in more detail than others. Had the final data sources and other practical matters been resolved earlier, they could have been examined more thoroughly. On the other hand, the limitations of a master's thesis should not be forgotten. Even if all data imaginable had been available on the first day of the process, the decision making process described in this thesis is such that one thesis could not cover all the aspects related to it in an exhaustive manner.

The unavailability of data is not only a restriction or a hindrance, but it has its advantages, too. As will be described later on, one of the key findings in this thesis is that data from external sources can be used to approximate actual demand data. The paths leading to this serendipitous finding would not have necessarily been explored had data from Company X been available from the beginning.

1.4. Structure

The structure of this thesis is shown in figure 1.1.

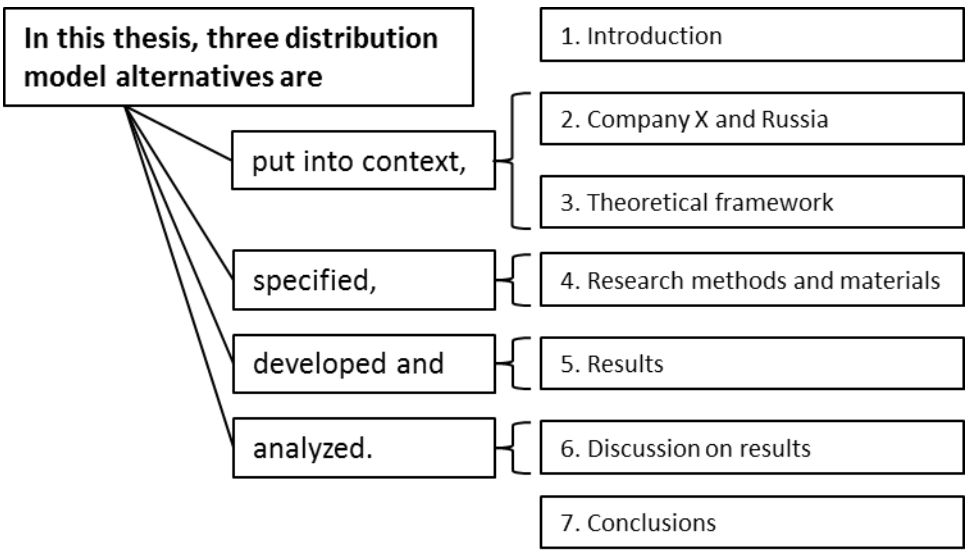


Figure 1.1. The structure of the thesis in sentence form and as the table of contents.

Following the order shown in figure 1.1., this first introductory chapter is succeeded by chapter 2, which provides general information on Company X, its ceiling-manufacturing business unit Company X Ceilings, suspended ceilings, its operations in Russia and the Russian market and economy in general. Both the current situation and future prospects are discussed.

Chapter 3 introduces the theoretical framework used in the thesis. Supply networks, distribution centers and their appearance in literature are described. After that, decision making concerning supply chains and distribution decisions is addressed.

Chapter 4 describes the research methods and materials. It starts by describing and listing the alternatives that are developed for different distribution alternatives. After that, the criteria used to compare and develop them are explained. These criteria are location optimization, choice of transportation mode, logistics costs, lead times, risks and sensitivity analysis. The data used in the thesis is also described.

The results of the thesis are given in chapter 5. Firstly, possible end-customer locations and locations based on actual sales data are compared. After that, the alternatives are assessed parameter by parameter. The results and their implications for Company X and other purposes are then further discussed in chapter 6. Finally, conclusions can be found in chapter 7, where the results are summarized, the plan of action is described and future developments and suggestions for further research are considered.

2. COMPANY X AND RUSSIA – CURRENT SITUATION, HISTORY AND FORECASTING

This chapter discusses Company X and Russia – both separately and in relation to each other. The first subchapter 2.1. gives background information on Company X and its business unit Company X Ceilings, which produces suspended ceiling systems, and suspended ceilings as such are described briefly as well. Thereafter, subchapter 2.2. analyzes Company X's current and future situation in Russia. The final subchapter, 2.3., gives a general description of the Russian economy and market to the extent that is relevant to Company X.

2.1. Company and product background

2.1.1. Company X – floors and ceilings

Company X is a leading global manufacturer of suspended ceilings, resilient floors and hardwood floors. The products are used in both renovation and new construction, and the end-customers are both in the residential and commercial segments. Company X is the leading brand in many markets. (Company X 2012a)

The history of Company X goes back to the 19th century, when it was started as a single shop (Company X 2013a). 150 years later, Company X is a global corporation with sales of $2.6 billion in 2012 (Company X 2013b). Table 2.1. shows information on Company X's sales profile:

Table 2.1. Company X sales profile (adapted from Company X 2012b and Company X 2013b)

Company X: $2.6 billion in global sales		
70% domestic (USA)	vs.	30% international (non-USA)
60% commercial	vs.	40% residential
70% renovation	vs.	30% new construction

As table 2.1. indicates, most of Company X's sales come from the U.S. market, and also the commercial and renovation segments outsize residential and new construction. These, however, are global averages, and they vary regionally and per business unit.

Company X is divided to business units, or segments, according to figure 2.1.

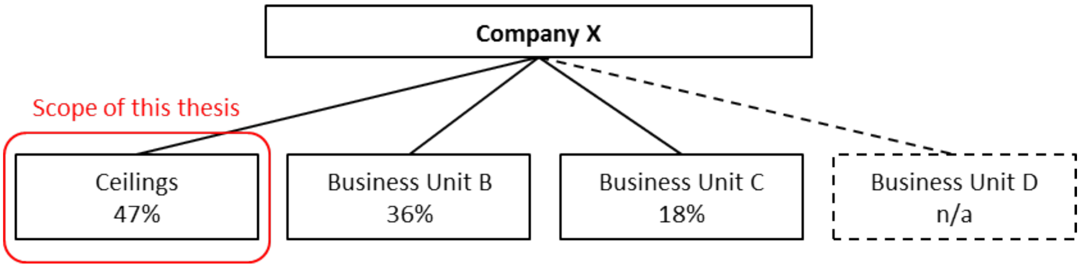


Figure 2.1. Company X segments with percentages of total 2012 global sales (adapted from Company X 2013b). Company X Ceilings is highlighted in red as it is the only relevant segment for this thesis. Business Unit D was discontinued in 2012.

The figure shows Business Unit D, which was discontinued in 2012 as an effort to concentrate resources to Company X's core competencies (Company X 2013c). As the figure indicates, almost half of Company X's sales come from Company X Ceilings, which manufactures suspended ceilings systems. The other business segments still in operation, Business Unit B and Business Unit C, will not be addressed in this thesis. Company X is discussed more in the next subchapter.

2.1.2. Company X Ceilings

For this thesis, only the business unit producing suspended ceilings, Company X Ceilings, will be addressed. The names Company X and Company X Ceilings will be used interchangeably in the thesis, but when context implies so, Company X means the entire corporation.

Company X Ceilings had $1.2 billion in worldwide sales in 2012 (Company X 2013b), and it operates thirteen manufacturing facilities in eight countries (Company X 2013c). Some key information on Company X Ceilings' sales is presented in figure 2.2. Although the numbers are from 2011, they should be similar for 2012.

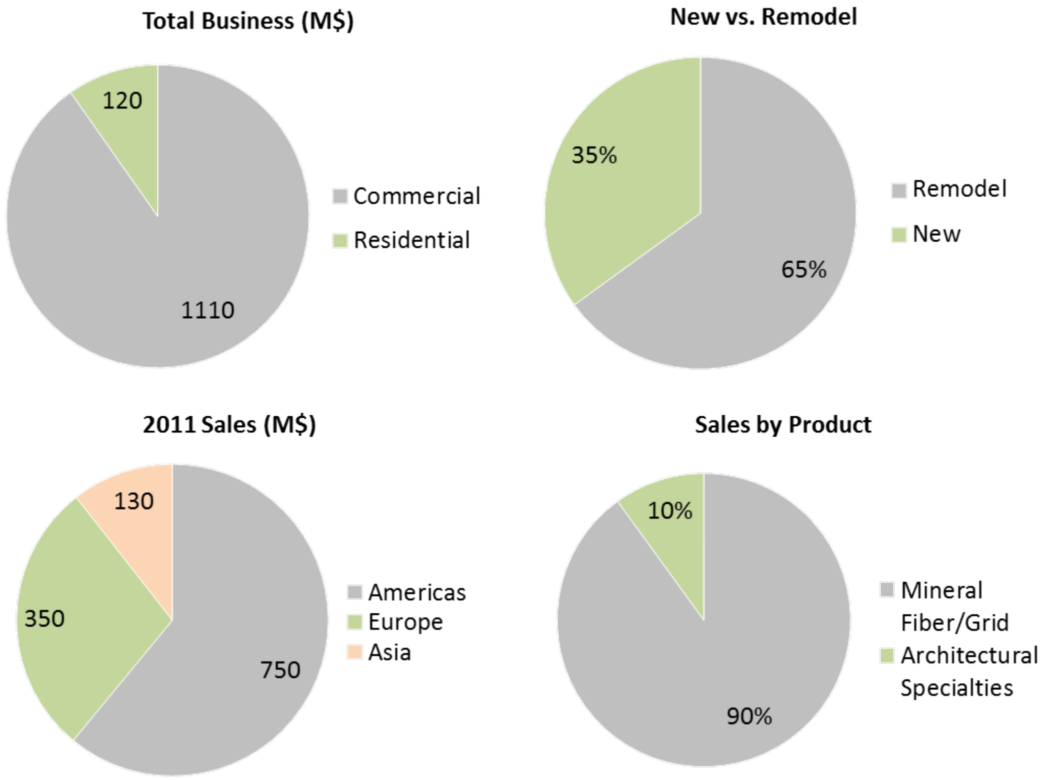


Figure 2.2. Company X Ceilings sales information from 2011 (Company X 2012b)

As figure 2.2. indicates, the vast majority of Company X Ceilings' sales comes from commercial projects, remodeling, the Americas and mineral fiber/grid ceilings. In North America, both commercial and residential segments are substantial, but elsewhere sales are commercial for the most part and come mainly from Europe (Company X 2012c, p. 6).

As for Russian operations, only the commercial end-user segment is relevant, as no residential suspended ceilings are offered. Globally, there is more variation within this segment than there are in the pie charts in figure 2.2. No single segment has the majority of sales, although offices are the largest segment. This can be seen in table 2.2.

Table 2.2. Company X Ceilings' sales by end-use segment (Company X 2013b)

Segment	% of business
Office	30-40%
Retail	20-30%
Education	15-25%
Healthcare	5-15%
Transportation/Other	5-15%

The numbers in the table concern Company X Ceilings globally, and the sales segments in Russia will be discussed later after suspended ceilings and Company X's supply work in general are described next.

2.1.3. The product: suspended ceiling systems

Suspended mineral fiber ceilings, which form the vast majority of Company X Ceilings' sales, are part of the larger suspended ceiling, or dropped ceiling, category. Dropped ceilings are a key construction component in almost every commercial building project as they offer a platform for lighting fixtures, smoke detectors and other necessities while concealing piping and wiring in the plenum, which is the space between the ceiling and the dropped ceiling. Ceiling tiles can be also easily removed to access the plenum for repairs and they can be replaced individually without removing the surrounding tiles or the grid. (Association of Interior Specialists 2006)

An example of a suspended ceiling is shown in figure 2.3. The characteristic tile-and-grid shape of the ceiling is clearly visible, and a multitude of lighting fixtures, ventilation valves, loudspeakers, smoke detectors and other devices are attached to the ceiling while their wiring and piping is hidden in the plenum.

Figure 2.3. A suspended ceiling system (Company X 2012d)

A suspended ceiling consists of a metal grid, hangers used to hang the grid from the actual ceiling and tiles which are placed on the metal grid. Standard sizes for the tiles are 600x600 and 1200x600 millimeters. Tiles can be manufactured from a variety of materials including mineral/rock fiber, glass fiber, plasterboard, glass reinforced gypsum, wood, steel or aluminum. (Association of Interior Specialists 2006)

2.1.4. Company X's supply network

Company X Ceilings operates ceiling tile plants globally: five in the United States, five in Europe, one in China and one in Canada. Mineral wool is produced at one plant in the United States as raw material for mineral fiber ceilings. (Company X 2013c) The metal grids for the ceiling systems are produced by a joint venture with another company. This cooperation is invisible to the customers as they buy a Company X ceiling system. (Company X 2013b) This joint venture has three plants in the United States, three in Europe, one in India and one in China. (Company X 2013c)

Raw materials are purchased worldwide in the ordinary course of business from many suppliers. Principal raw materials for the manufacturing of ceilings include mineral fibers, fiberglass, perlite, waste paper, pigments, clays, starches and steel used in metal ceilings and grids. Packaging materials, energy and water are also consumed in significant amounts. In general, raw materials are available in adequate amounts, but disruptions may happen as a result of changes in laws and regulations or other industries competing for the same materials, for example. (Company X 2012c, p. 7) Raw materials, however, are irrelevant concerning the scope of this thesis, as it is concerned only with distribution.

Globally and in the commercial segment, finished products are delivered to the distributors, who re-sell them to retailers, builders, contractors, installers and others. In the North American residential markets, Company X has also important relationships with national home improvement centers (Company X 2012c, p. 6). In Russia, as will be described later, the situation is different, and distributors come to the logistics center in Saint Petersburg to collect the products. This and other aspects of Company X in Russia are discussed in the next subchapter.

2.2. Company X in Russia

2.2.1. Market share and future growth in Russia

Company X brought the suspended ceiling category to Russia in 1992 and currently it holds a 60% share of the "western" tier market in suspended ceilings. The brand is strong and has first-mover advantage. The Russian market is the third largest in the world and will grow significantly in the future. (Company X 2012a)

in Russia, 85% of the current suspended ceiling market is in the office and retail segments whereas healthcare and education offer opportunities to grow (Company X 2012b). Product conversion is also a key sales opportunity, as the Russian market moves from drywall ceilings to mineral fiber ceilings, which offer improved acoustics, hygiene and fire safety (Company X 2012a).

The Russian market is expected to grow as is the market share of Company X. Suspended ceilings have not yet penetrated all of the segments, and especially healthcare and education are largely unsaturated. According to management estimations for new building projects, suspended ceilings penetration is 70% in offices and 85% in commercial buildings but only 20% for education and 30% for healthcare. Two key market growth opportunities are increasing this penetration to western levels, meaning more than 90%, in new construction and upgrading existing schools and hospitals to suspended ceilings. (Company X 2012a)

Company X's goal is to increase their profits in Russia through product mix. From 2006 to 2012, the sales have gone up 39%, but the increase has been significantly higher, 58%, in mid-to-high end items (>$4.6/m^2), whereas the sales of low end items (<$4.6/m^2) have increased by 11% only. (Company X 2012b)

2.2.2. Company X's current operations in Russia

The information in this subchapter is based mainly on an excursion to Yanino Logistics Park in Saint Petersburg in February of 2013. There the author interviewed top- and middle-management representatives of both Containerships and Company X. As such, separate sources are not indicated, and the text is written on a rather generic level to avoid any incongruity between verifiable numbers and what were said by the interviewees.

Currently, all goods are imported to Russia via Saint Petersburg. They are produced mainly elsewhere in Europe: in the United Kingdom, Germany or France.

The goods arrive by sea to the terminal Moby Dick, which is situated on Kotlin Island, near Kronstadt, outside of Saint Petersburg. A ring road from the Moby Dick terminal takes them to Yanino Logistics Park on the eastern side of the city, where they are stored. This leg of transportation and warehousing is carried out by the Finnish company Containerships Ltd Oy, whose sister companies own partially both Moby Dick and Yanino.

Distribution from Yanino is organized on an ex works basis, which differs from the delivery models used in almost all other markets. This means that distributors come to collect the goods from Yanino using trucks from their own fleet or from third party carriers. Thereafter the distributors take the goods to their own distribution centers to be sold further.

In the past, the distribution has happened mainly through three larger Moscow-based distributors who constitute roughly over 50% of Company X sales and, as such Company X has not accumulated data on the second tier of distributors and retailers or end-customers. Thus Company X does not have specific information on parameters such as the geographic distribution, volumes or stock-keeping unit (SKU) profiles of the end-customers. This information would be relevant for future developments if more direct contacts to the end-customers are pursued. However, as will be shown later on in the results chapter, demographic data on the Russian market yields some understanding of where the end-customers may be situated.

The ex works model causes problems for Company X because of the ill-fitting fleet of the customers and the fragility of the products. Trailers coming to Yanino may be too short, too low, have broken hydraulics which complicate the docking to the loading bay, or the trailers may have a variety of obstacles on their walls, floor or ceiling obstructing the loading. As the strategy is to deliver full truck loads with pallets laden to their maximum height, any little incompatibility of the trailer can be crucial.

Damages to the products during shipping and handling are also significant. The ceiling tiles are mostly 60x60 centimeters, and four cartons are piled per layer on a pallet to reach ten or eleven layers. Most trailers carry 22 pallets, and the space within the trailer is carefully used. Thus the fork-lift handling and any shifting during transportation damage the fragile tiles easily. If there is a plank on the side of the trailer extruding a mere few centimeters, for example, the side of the pallet will most likely hit it and damage the corners of the tiles.

2.2.3. Future operations in Russia

Company X is building a manufacturing plant in Tatarstan, some 800km east of Moscow. The plant will produce about 80% of the volume of products, but only around 20 SKUs, whereas the entire offering consists of some hundreds of SKUs. In fact, the most popular mineral ceiling tile, which will be produced in Tatarstan, constitutes roughly 50% of all sales by volume. Thus the SKUs produced in Tatarstan are commodity items whereas the rest are higher in price and lower in volume, and they will be still imported to Russia through Saint Petersburg. Also, all of the grids needed for the ceiling system will still be imported. The Tatarstan plant will become operational during the first or second quarter of 2015, and the ramp-up phase will take approximately a year.

The locations of the logistics park Yanino in Saint Petersburg and the site for the manufacturing plant in Tatarstan are illustrated in figure 2.4. The figure, as all other two-dimensional maps, does not do justice to the sheer size of Russia. Other than distorting its outline, a two-dimensional map makes no reference to the highly uneven geographical distribution of population in Russia. Without any information on the distribution, one would argue that Yanino and Tatarstan are situated clearly to the west of the country, but in fact three fourths of Russians live west of the Ural Mountains in European Russia (Finpro 2012), which makes the positioning of the two facilities far more logical.

Figure 2.4. The locations of the Yanino warehouse and the Tatarstan plant. (Map base from Wikimedia 2007)

This division of Russia along the Ural Mountains is a crude simplification, and the Urals are not an unconquerable geographical formation – they can be crossed. The division, however, is a simple heuristic to help manage the uneven distribution of population in Russia. It is also one that will be used in this thesis, and some of the alternatives used will divide demand along the Urals leaving some distribution centers to serve population east and others population west of the Urals.

The current distribution hypothesis in Company X, which makes no reference to the Urals, is that there will be a commodity distribution center a few kilometers away from the Tatarstan plant and a non-commodity distribution center at the current location in Saint Petersburg after the completion of the new plant, and both distribution centers will serve all of Russia. This setting will be used in the thesis as a base case against which other alternatives are compared.

2.3. The Russian economy and market

2.3.1. Societal considerations in Russia

When a company enters an emerging market, economic, legal, political, socio-cultural and technical conditions in the market may have complex influences - both negative and positive - on all components of the entry strategy (Kouznetsov 2009). The Russian economy and market are no exception with their most dominant characteristics being sheer size and unsettledness after the collapse of the Soviet Union. Company X is not new to the market, but starting manufacturing in the country puts the company in a new position.

Compared to more stable Western markets, Finpro (2012) lists strengths and weaknesses for Russia in general. These characteristics are very general and, obviously, vary between different regions. They are summarized in table 2.3.

Table 2.3. Strengths and weaknesses for Russia (adapted from Finpro 2012)

Strengths	Weaknesses
Size of the economy, purchasing power, natural resources. Strong current account surplus. Established political structure, Putin's renewed presidency shows political stability. IT market is fast-growing. New liberal immigration laws boost economy.	One of the most corrupt countries. High unemployment. High mortality and morbidity. State interferes repeatedly in the economy affecting the private sector's dynamism.

Although more strengths are listed than weaknesses, it is clearly visible that the list of weaknesses is nothing short of catastrophic by western standards. Kouznetsov (2009) goes as far as to suggest that Russia is the least stable of the emerging markets. Corruption, unemployment, mortality and morbidity are phenomena that are not outweighed by somewhat marginal positives such as the growth rate of the IT market or liberal immigration laws. The Russian society is one with severe problems, with which it has struggled since the collapse of the Soviet Union – and even before that.

Modernization is a word commonly used in the Russian societal discourse. For his renewed presidency starting from 2012, President Vladimir Putin set out ambitious goals to increase productivity, create jobs, raise wages, add investments and make other improvements. The actual effect these attempts have remains to be seen and their failure may lead to Putin's political credibility crumbling. (Kosonen et al. 2012, p. 4) The issue with program is its schedule: the goals per se may be achievable, but there is no motivating force behind them. Historically, all other rapid developments in Russia have been driven by crises and dire need, but Putin's program is only political in nature, and political programs have had a tendency to wither without any mentionable achievements. (Kosonen et al. 2012, p. 81)

In addition to the lists in table 2.3, the Ministry of Foreign Affairs of Finland (2012) mentions weak infrastructure as a significant weakness for Russia. It considers investments in modernizing the infrastructure as a means to increase economic growth. This would require a better investment climate, which is currently repressed by heavy bureaucracy, a weak judicial system, insufficient legislation and widespread corruption. (Ministry of Foreign Affairs for Finland 2012) Martin (1999, p. 140) goes as far as to say that even though Russia represents potentially the most valuable market for western companies, it is an exceptionally difficult market for foreign firms to operate in because of the same aforementioned reasons: corruption, bureaucracy, weak infrastructure and the general "absence of law and order."

Not only does the problem exist on a federal level, but there are great differences between different regions as well. Stoner-Weiss (2000) even suggests (but does not provide adequate evidence to justify her claim) that, in Russia, there is a correlation between the effectiveness of a given regional government and the amount of foreign direct investment that the region attracts, meaning that the lack of instability and bureaucracy would be clearly evident in foreign direct investments. According to her, this regional stability is oftentimes reached as a result of high consensus among political and economic elite and low political pluralism, which can be harmful for democracy in the long run. Stoner-Weiss (2000) also includes Tatarstan, where Company X's new plant will be situated, as one of the three resource-rich regions in Russia alongside Sakha (Yakutia) and Bashkortostan that are the most aggressive in attracting foreign direct investments by offering tax concessions to investors, establishing special tax-free economic zones, such as the special economic zone in Tatarstan where Company X is building its plant, and by other means.

Russians, however, have a different outlook on their problems. In a survey conducted on small and medium-sized Russian businesses, the respondents mentioned weak availability of workforce, withering demand and financing as their largest problems. Only after these – and with percentages less than half of those of the top three alternatives – were unfair competition, corruption, weak infrastructure and bureaucracy mentioned. (OPORA 2011, p. 40) This discrepancy could be attributed to corruption, for example, being so deep-rooted in the system and Russians being accustomed to a dysfunctional society so that they consider it to be a normal state of affairs, not a problem (Kosonen 2011, p. 11).

2.3.2. Economic development in Russia

As for gross domestic product (GDP) development, the post-Soviet Russia has witnessed changes in this millennium: The first decade was one of fast growth followed by a depression coinciding with the global economic downturn. Thereafter, the economy has regained a slower growth pace.

The Russian GDP grew rapidly during the first decade of the 21st century. This growth is contributed to unusually high total factor productivity growth, while capital stock and labor grew by only 1% per year (International Monetary Fund 2012, p. 6). (International Monetary Fund 2012, p. 3-6) TFP is a variable which accounts for changes in total output not caused by inputs (Encyclopaedia Britannica 2013b). Thus the growth is fueled by advances in technology, for example.

The Ministry of Defence of Finland (2012, p. 71) attributes most of the growth during the 2000s to the increase in oil prices and availability of production capacity that has been idle since the 1990s. Luo (2002, p. 356) specifies this capacity to be converted from military industrial facilities that Russia inherited from the USSR. The dependency between the growth of the Russian economy and oil price is not merely a common assumption, but it seems to be so also in the light of statistics. During the 1990s, there was a clear correlation between these two: a 10% permanent increase or decrease in the price of oil was associated with a 2.2% growth or fall (respectively) in the level of Russian GDP. A similar effect also applies to the real exchange rate of the ruble. (Rautava 2002)

After almost a decade of rapid growth, Russia's GDP fell by 8% in 2009. Thereafter, the GDP has returned to a growth track. The economic growth is expected to remain slow at least during 2013 as a result of insecurity in the global economy and trade, which affects the heavily oil and gas dependent Russian economy. (Ministry for Foreign Affairs of Finland 2012)

The base rate of forecasts for GDP growth in the upcoming years is 3-4%, which may be less if the global situation worsens. Private spending and the growing middle class are expected to increase domestic demand thus supporting economic growth. (Ministry for Foreign Affairs of Finland 2012) This slow growth is due to the absence of the phenomena that made growth possible: oil investments will wither, oil price will stay steady and there is little idle capacity to be harnessed. (Ministry of Defence of Finland 2012, p. 71) GDP development and forecasts for Russia and other key markets for Company X, the United States and the Euro zone, are compared in figure 2.5.

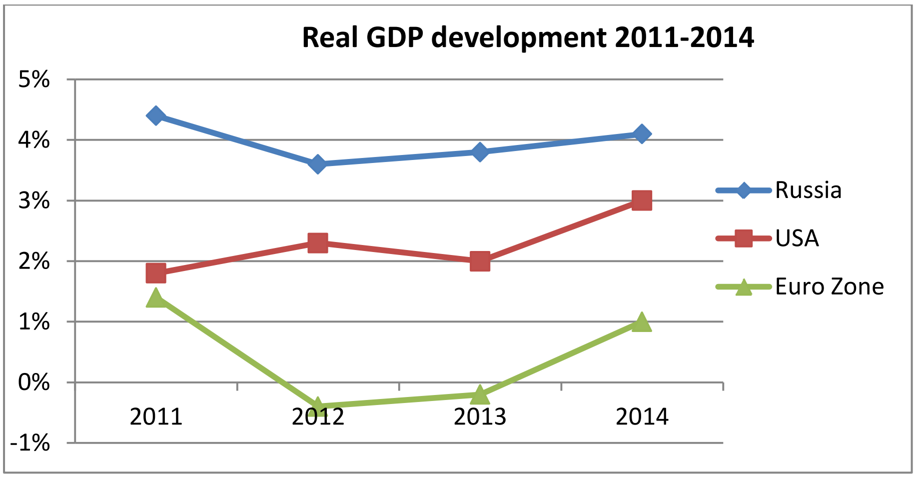


Figure 2.5. Real GDP development in Russia, the United States and the Euro Zone. 2011 and 2012 are based on actual developments, 2013 and 2014 are IMF forecasts. (International Monetary Fund 2013)

As is with GDP development in figure 2.5., the construction industry is growing in Russia at a pace above global average – and substantially better than Western Europe. This growth is due to increased private investment in commercial, industrial, infrastructural and residential construction projects, but it also owes to various international events organized in Russia such as the Winter Olympic Games 2014 in Sochi and the Fifa World Cup 2018. Other than these events, some key opportunities in the industry include the Moscow expansion, Skolkovo innovation center and the plans to invest in the hospitality, retail and residential sectors. (UK Trade & Investment)

A key component of the Russian construction market is renovation and upgrading to western standards. Most Russian residential buildings were constructed during the Soviet era, and after the fall of the Soviet Union, they were either privatized or moved over to municipal ownership. Moscow and Saint Petersburg have been able to keep up with construction modernization and new building, but in most parts of Russia the majority of buildings, apartment buildings in particular, are in a deteriorated state. This offers enormous potential to construction companies, and obviously residential buildings forms a large part of the new build market their percentage being 90 % of all new construction. (Rinne 2007, pp. 11-12) The residential building sector, however, is rather irrelevant to Company X, as it does not target the residential buildings with its suspended ceiling systems.

Globally, the majority of Company X’s revenue comes from renovation, and its sales are not dictated directly by volatility in the new-build construction industry. In Russia, the situation is different, however, as new-build construction is booming and there is constant demand for construction materials. Annual construction cycles with nearly all construction happening during the summer do not affect Company X as much as “normal" construction industry, because suspended ceiling systems can be added or altered year round, and thus their demand is quite level.

A major change that will affect the Russian economy and market is Russia's membership in the WTO. Russia was officially accepted as a member state in December of 2011 and joined the WTO in August of 2012, which has had a great impact on liberalization of import tariffs. (International Trade Centre 2012, pp. 24-25) This will make the importing of products easier for foreign companies, but it cuts the state budget and is to some extent harmful for in-country production plans like Company X's: high import tariffs were an important reason to pursue in-country production for many companies, and lowering them will lessen a company's competitive advantage in relation to competitors importing their products. However, the import tariffs vary between different industries and products. On average, they will be lowered only by 3%, and their effect is mitigated also by long transition periods (Kosonen et al. 2012, p. 53).

2.3.3. Supply chains and cooperation in Russia

Supply chains in Russia, as many other phenomena, differ from the western markets in their working. As a supply chain is a dynamic network of companies, the ties between companies play an important role in its success. Personal networks overlap with business networks, and oftentimes these two are indistinguishable.

As a remnant of the Soviet Union, the Russian society has a form of "camaraderie" called *blat*. During the Soviet era, blat referred to the exchange of services and products between individuals bypassing the official route, which was oftentimes slow and bureaucratic. Thus someone working at a grocery store, for example, may have exchanged its products to the services of a doctor. The arrangement benefitted both of them, since groceries and medical services were on short supply via the bureaucratic route. Although blat never officially existed and its role has diminished, echoes of it can still be seen in the business world today. (Mattsson & Salmi 2013)

Whether it is a result of blat or some other historical development, Russians have an inherent distrust towards outsiders. This creates problems establishing and developing business relationships for non-Russian firms. Kuznetsov & Kuznetsova (2005) even suggest that building up informal relations is imperative as "the bounding power even of the most explicit contractual agreements may be inadequate."

As a response to this, foreign firms often interact in Russia through Russian companies. This is also a remnant of the Soviet era, as it was rare for foreign companies to contact their end-customers. After the collapse of the Soviet system, foreign companies began building ties with local companies, and personal networks were considered a prerequisite for this. (Mattsson & Salmi 2013) An extreme example of an arrangement passing the conventional channel is the traffic infrastructure surrounding Skolkovo innovation center. A Russian company, Mostotrest, was chosen by president Medvedev to carry out the constructions without competitive bidding. This was perfectly legal, as Russian legislation allows the president bypass the bidding process in urgent situations. Regardless of the legality of its practices, infrastructure building in Russia is concentrated to 5-6 companies, which have good relations with the government. This has led to a situation where building roads is three times as expensive in Russia as it is in the west. (Kosonen et al. 2012)

The peculiarities of the Russian business environment hinder the advancement of a company like Company X. As an "outsider", the company has to operate through local intermediaries, whose role may not be advantageous for Company X over time. Ways to overcome this are discussed in the second part of the next chapter where internationalization is discussed. Before that, however, supply chains and distribution are described on a general theoretical level next.

3. THEORETICAL FRAMEWORK

A theoretical background for the thesis is given in this chapter. Subchapter 2.3. on the Russian economy and market relied on literature, and this chapter continues along those lines. The theory is general and not specific to Russia, although it is mainly selected to fit the scope of this thesis and Russian conditions.

This chapter is divided to two subchapters. In the first subchapter, 3.1., supply chains, distribution and distribution centers are discussed. The subchapter starts from rudimentary principles and then develops them further and applies them to Company X.

After distribution-related questions are discussed, internationalization and the methodology of decision making are analyzed in subchapter 3.2. in further detail. A theoretical model for internationalization and another theoretical model for decision making are applied to Company X's situation. Decision making criteria mentioned in the model and other sources are adapted to the use of this thesis. The criteria – location optimization, mode of transportation, logistics costs, lead times, risks and sensitivity analysis – are then described in their own subchapters.

3.1. Supply chains and distribution

3.1.1. Distribution in the supply chain

Distribution is part of the supply chain and it involves the transportation of goods from the producer to the end-customer (Encyclopaedia Britannica 2013a). Stevenson (2011, p. 644) gives a conceptual example of a typical supply chain in a manufacturing environment, and it is shown in figure 3.1. with distribution separated from the supply chain. The arrows indicate the direction of materials and finished products flowing downstream in the supply chain. Other flows include the flow of information and money and reverse logistics (Stevenson 2011, p. 644; Ballou 2004, p. 8), but they are not presented in the figure.

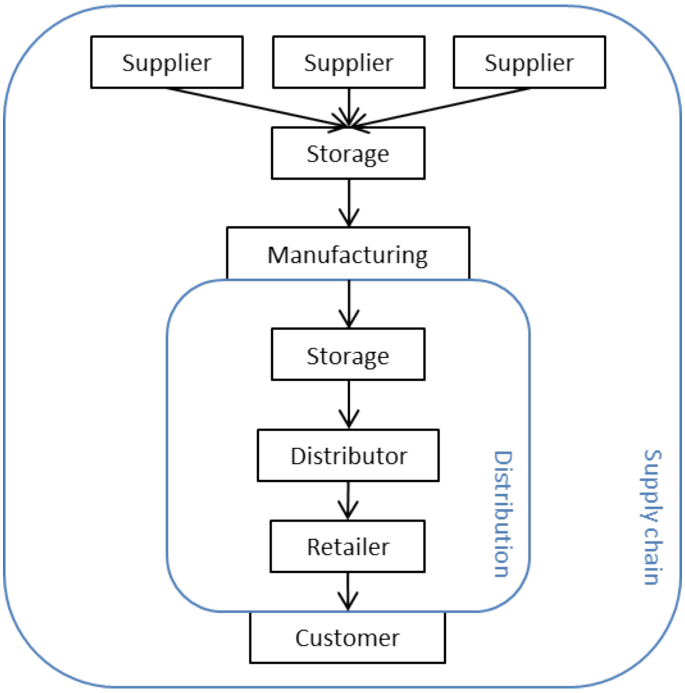


Figure 3.1. An example of distribution in the supply chain (adapted from Stevenson 2011, p. 644)

This example is similar to Company X's situation: goods are transported from manufacturing to storage whence distributors collect them to their own distribution centers. Ultimately, the products are delivered to the end-customers, and a separate retailer echelon does not exist per se. Stevenson's example is clearly created from the point of view of a single customer or product as there is only one customer, one retailer and so on. In an actual supply chain, the number of participants would multiply downstream from manufacturing: the number of storage facilities, distributors and especially retailers and customers is seldom only one. When complex products, such as cars or cell phones, are produced, the supply chain is far more complex upstream, also, and there may be hundreds of suppliers.

In figure 3.1., no separate text boxes are used to show transportation between different facilities. However, transportation is needed in most occasions between the different steps – even if the warehouse is situated in the same building as manufacturing, the finished products have to be transported between the two by forklifts or other in-house logistics measures. Thus one could argue that every arrow in the figure is a separate transportation event.

Naturally, the structure of the supply chain and the organization of distribution vary from one company to another. If multiple steps, or echelons, between manufacturing and the end-customer exist, inventory can be handled my multi-echelon inventories, which refers to planning inventory levels in the different echelons simultaneously and in accordance with each other (Ballou 2004, pp. 334-335). This, however, requires close cooperation between the different parties and is most suitable for situations where the manufacturing company is in charge of the entire outbound logistics chain with as few intermediaries as possible (Simchi-Levi et al. 2003, p. 69). In a situation like Company X's, where distributors are in charge of the process after they receive the products, such harmonization of inventory levels is impractical.

The scope of investigating a distribution channel is, of course, defined by the extent to which changes can be made. If a manufacturer controls the distribution channel all the way to the end-customer, it is simpler to solve problems within the distribution channel as a whole. However, if the manufacturer considers its distributor to be the end-customer, the distribution channel ends at the distributor. Thus the manufacturer's distribution channel can even be considered to be limited to finished products being transported from manufacturing to distributors. Such transactional views of the supply chain have historically been the focus of companies, but extending it to the entire supply chain is an emerging alternative – and a reason why the concept "supply chain" has even come to existence (Ballou 2004, p. 8).

The scope of this thesis is more specific than supply chains in general - or even distribution. Namely, this thesis is interested in the transportation from manufacturing to distributors. In figure 3.2., the part of Stevenson's supply chain example that is relevant to this thesis is highlighted. The example is not identical to Company X's situation, but the principle is the same: transporting products from manufacturing to distributors.

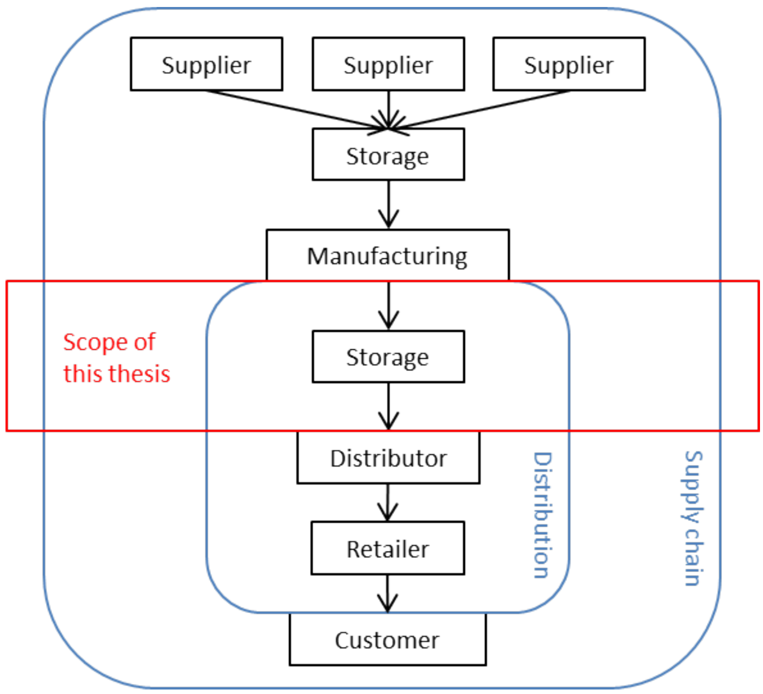


Figure 3.2. Scope of this thesis visualized in a supply chain example (adapted from Stevenson 2011, p. 644)

In short, the scope of this thesis consists of outbound transportation from the manufacturing plant in Tatarstan and Yanino, the warehouse in Saint Petersburg, to one or more distribution centers and from then on to the distributor. In a larger, strategic sense, the role of distributors in general is discussed, but their existence is still considered as a prerequisite for the alternatives developed.

Company X's distribution situation post-Tatarstan is visualized in a greatly simplified form in figure 3.3., where it has been fitted to Stevenson's example. The figure depicts the steps in Company X's supply chain downstream from manufacturing. Only four symbolical distributors are drawn, and their function is to show that some distributors are catered to by one distribution center (DC X) and the rest by the other distribution center (DC Y) – if two new distribution centers are chosen. The amount and direction of the transportation flows may vary, too, and although there is no arrow between Yanino and distribution center Y, some transportation would most likely happen.

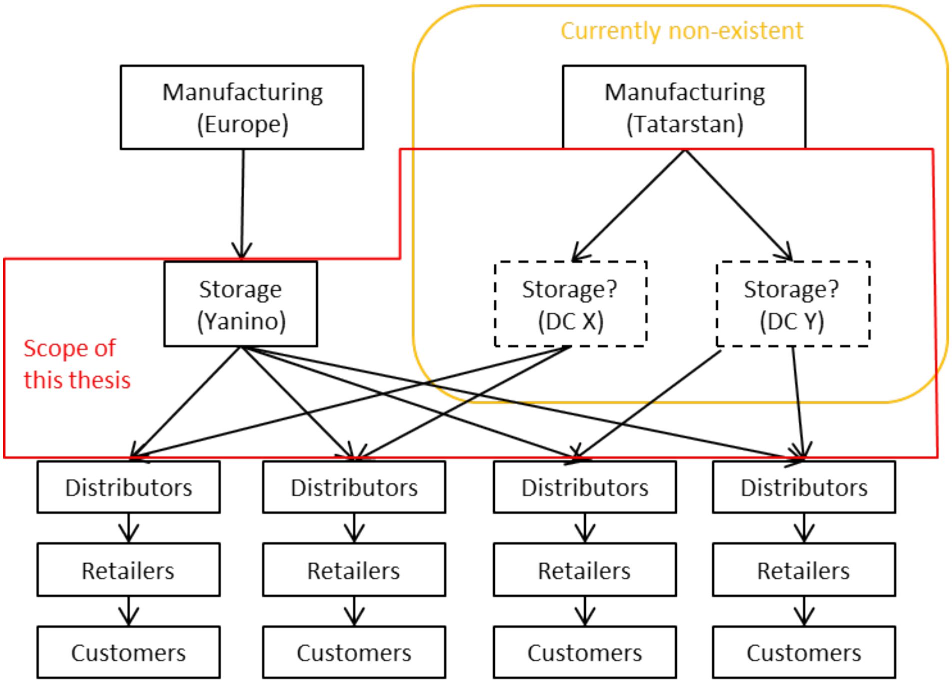


Figure 3.3. Company X's future supply chain in Russia downstream from manufacturing. The nodes with a solid line are "set in stone" whereas the dashed-line nodes – the distribution centers – are still speculative. The transportation between nodes depends on their final configuration.

Figure 3.3. could be drawn in a number of different ways by omitting one distribution center, drawing more or fewer transportation arrows, echelons of distributors and so on. Thus the figure above is mostly an attempt to present visually what possibilities are discussed in this thesis and what elements constitute them. What is essential is the conceptual division between products coming from Europe and from Tatarstan. The current

situation is similar to the left side of the figure, and the nodes for Tatarstan and distribution centers X and Y do not currently exist at all.

Other than visualizing the future situation, the value of figure 3.3. is in defining the currently non-existent parts of the supply chain and the scope of this thesis: the part of the figure where these two overlap is what is borne in this thesis. These new storage nodes are distribution centers, and the theoretical significance of distribution centers in the supply network is discussed in the next subchapter.

3.1.2. Distribution centers in the supply network

According to Higginson & Bookbinder (2005, p. 67), distribution centers are a forgotten area of the supply chain management. They suggest that researchers have ignored distribution centers in their papers, and a multitude of supply chain management books from the late 1990s onward do not discuss material on warehouses or distribution centers – or even mention them in their indices. This applies to supply chain management and operations management books such as Krajewski et al. (2013) and Stevenson (2011), which both address distribution centers and warehouses only among other operations and their subject indices only mention warehouse layouts.

Researchers (and text book writers) seem to assume that there will always be a distribution center to serve other functions of the company, and it will cater to all of their requirements (Higginson & Bookbinder 2005, p. 67). Distribution centers, of course, are subject to the same limitations and requirements as any other nodes or processes in the supply chain, and thus they cannot simply appear from thin air.

Although distribution centers are disregarded in recent literature, they play an important role in the supply chain serving many purposes. The main roles that distribution centers play are those of

- a make-bulk/break-bulk consolidation center,
- a cross-dock,
- a transshipment facility,
- an assembly facility,
- a product-fulfillment center,
- depot for returned goods and
- miscellaneous other roles such as the coordination of inbound and outbound vehicles, customer support or space for retail sales as a factory-outlet store. (Higginson & Bookbinder 2005, pp. 71-80)

Breaking bulk and making bulk mean disaggregating large incoming loads for product mixing and to create consolidated outbound shipments. (Higginson & Bookbinder 2005,

p. 71) In Company X's case in the current situation, this means taking cartons from different pallets and creating new pallets of them to be sent out.

A cross-dock is a distribution center where warehousing is eliminated altogether, and goods are rerouted at the earliest possible hour. Some consolidation or sorting may happen. Cross-docking is a form of transshipment, and they differ mainly in objective. Cross-docking is customer-focused and aims to get the goods to the customer as early as possible, and transshipment is a carrier's strategy that aims to better fit the load with the right vehicle. Transshipment where no items are added or removed from the load is also called transloading. (Higginson & Bookbinder 2005, pp. 72-74)

The rest of the roles have a lesser role for Company X. As an assembly facility, a distribution center may be part of mass customization, for example (Higginson & Bookbinder, p. 78). This is not the case at Yanino currently, and it would hardly be beneficial in the future either. As a product fulfillment center, a distribution center answers to product orders from the final consumer (Higginson & Bookbinder 2005, pp. 78-79). This is also redundant as Company X has its own sales division that deals with the distributors who, in turn, are responsible for customer contacts. What is relevant, however, is the role as a depot for returned goods. Much of the products are damaged during transportation and currently Yanino holds large amounts of damaged goods.

As with other phenomena, decisions related to distribution centers and supply chain management in general appear on three different levels: strategic, tactical and operational. Some decisions are fitted to these three levels in table 3.1. The purpose of the table is to give examples of these different decisions, not to provide an exhaustive list.

Table 3.1. Supply chain decision levels (adapted from Simchi-Levi et al. 2003, p. 8)

Strategic level	**Operational level**	**Tactical level**
Number, location and capacity of warehouses and manufacturing plants Flow of materials through the logistics network	Purchasing and production decisions Inventory policies Transportation strategies (e.g. customer visitation frequency)	Scheduling Lead time quotations Routing Truck loading

The level concerning this thesis is mostly strategic, as the alternatives proposed in it concern the entire Russian market and are possibly applicable to other countries of the Commonwealth of Independent States (CIS) as well. Even if the number of distribution centers is limited to one or two and even more tactical details could be discussed in the solutions, the implications of the decisions made are corporate-wide and unquestionably strategic. The distribution models created in this thesis suggest strategic guidelines to which the tactical and operational layers can be added afterwards.

Whether a decision is strategic, operational or tactical is questionable, however. The choice of routing and transportation mode may be considered tactical, but it can only be done within the limits that have been established in the strategic level. Thus railroad transportation cannot be used unless the facilities are placed near a railway connection, and considerations such as that should be made already while planning the strategic framework.

3.1.3. Distribution center or warehouse?

Distribution centers form a specific subcategory of warehouses, but their difference has become obscure and ignored by authors and researchers (Higginson & Bookbinder 2005, p. 68). Ballou (2004, p. 474) uses the term "distribution warehouse" synonymously with distribution center. He divides warehouses to holding warehouses and distribution warehouses, and this division is show in 3.4.

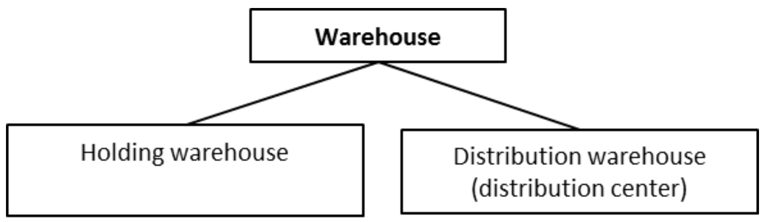


Figure 3.4. Types of warehouses (adapted from Ballou 2004, p. 474)

Higginson & Bookbinder (2005, p. 68) define distribution centers as "a type of warehouse where the storage of goods is limited or non-existent." Thus distribution centers focus on product movement and throughput combined with information collection and reporting instead of simple storage.

Daww (1995) provides definitions to differentiate distribution centers and warehouses, and among them are two that fit Higginson & Bookbinder's views:

- warehouses store all items whereas distribution centers maintain minimum inventories of predominantly high-demand items
- warehouses handle products in four cycles (receive, store, pick and ship) whereas distribution centers only have two cycles for most products (receive and ship) (Daww 1995)

Cross docking, which was mentioned in the previous subchapter, is an extreme form of distribution centers, and it fits the latter of Daww's aforementioned criteria. Holding warehouses are used for semi-permanent or long-term storage and distribution centers for temporary storage, but cross docks eliminate storage altogether. They transfer goods directly from inbound to outbound making-bulk or breaking-bulk. (Ballou 2004, pp. 474-475) Cross docking has several drawbacks due to its complexity, and it is best applicable to just-in-time and make-to-order environments (Higginson & Bookbinder 2005, p. 74).

Theoretical discussion on the differences between distribution centers and holding warehouses is irrelevant in practical applications, since most real-life distribution centers are a compromise somewhere between the two theoretical extremes. In this thesis, the term distribution center is used to describe the sort of warehouses suggested for Company X even if they do not match the theoretical definitions precisely.

3.2. Decision making

3.2.1. Internationalization: the Uppsala model

Questions about internationalization are the uppermost strategic level related to Company X's operations in Russia and the scope of this thesis; after all, the developing of a distribution model becomes unnecessary if the company decides to discontinue its operations in the market, for example.

The Uppsala model is an internationalization process model developed by Johanson & Vahlne (1977) based on empirical observations made on the internationalization of Swedish companies. It holds that "internationalization is the product of a series of incremental decisions", and it divides the internationalization process in to four steps, which are applicable to Company X's situation as well. The key is that a gradual approach is needed when a company lacks information on the new market. In order to gain information, the company has to operate in the market, and the safest way to do so is to adopt a step-by-step approach (Johanson & Vahlne 1977).

The underlying observation is of the Uppsala model is that this approach is adapted by companies that are profit-maximizing yet risk-averse. Gradual development is preferred, and the progress is a result of growing market knowledge and market commitment. (Johanson & Vahlne 1977) Market commitment is the product of the size of commitment and the degree of its inflexibility. Thus heavy investments in saleable machinery, for example, are not considered equally committing, as the machinery can be resold with relative ease. (Johanson & Vahlne 2009) A gradual approach is needed because the company lacks information on the new market. In order to gain information, the company has to operate in the market, and the safest way to do so is to adopt a step-by-step approach. (Johanson & Vahlne 1977) The model is shown in figure 3.5. In the figure, the advancement of Company X is shown next to the Uppsala model, as the path followed by Company X is remarkably similar to the model.

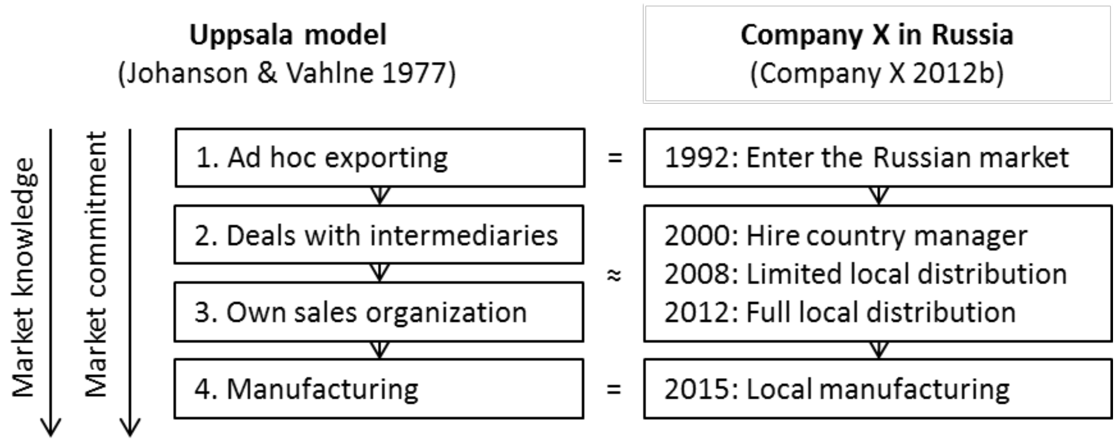


Figure 3.5. The Uppsala model compared to Company X's business evolution in the Russian market.

The model attributes the level of caution that a company takes in developing its operations in a country to *psychic distance*, which means the cultural differences between two countries that are not explained by geography (Johanson & Vahlne 1977). This term is reworked in Johanson & Vahlne's (2009) newer article to be *outsidership*, which highlights the meaning of networks as oppose to their earlier, more neoclassical view of the market as a collection of independent suppliers and customers. Psychic distance or outsidership, of course, is a significant factor in a situation like Company X's, where most of its business has traditionally come from the western markets and it is only starting to fulfill the potential of the markedly different Russian market – and an explanation to why it has taken Company X over twenty years to start reaching the last step of the Uppsala model. Even if the markets in Western Europe are geographically close to Russia, the cultural (and, historically, ideological) distance is immense.

The Uppsala model and Company X's actual route to local manufacturing are similar. The division that was shown figure 3.5. was based on Company X's own writing of the company history in their investor presentation, and the development could most likely be presented in a manner that fits the model even better since the phases between 2000 and 2012 do not directly follow steps 2 and 3. However, as Johanson & Vahlne (2009) state in defense of their model, "the aim of theory building is not to replicate a complex reality; it is to explain its central elements."

The main difference between Company X in Russia and the Uppsala model is in the application of an own sales organization. Currently Company X still operates mostly via intermediaries, and although the number of direct contacts to contractors bypassing the distributor echelon is growing, step 2 of the Uppsala model still exists strongly. The model, however, is naturally a mere simplification of real-life processes. No real company moves seamlessly from one step to the other, and Company X moving to local manufacturing (step 4) itself could be seen as an attempt to diminish the role of intermediaries.

Although this thesis adheres to a lower strategic level by developing a distribution model – at least from the point of view of the entire corporation – the baseline of this higher strategic movement and elimination of intermediaries is considered while developing the alternatives. The proposals are not made to cater only to the needs of current distributors. On the contrary, the increase of direct contacts to contractors in the future is observed and the demand projections take this into account.

The possibility of a future without intermediaries is visualized in figure 3.6., which utilizes yet again the same distribution construction shown earlier in this thesis. This time distributors and retailers have been eliminated leaving the distribution chain to be quite simple. In the figure, two echelons of intermediaries, distributors and customers, are eliminated. This is not exactly how Company X's distribution channel works, as most often the end-customers deal with distributors, not separate retailers.

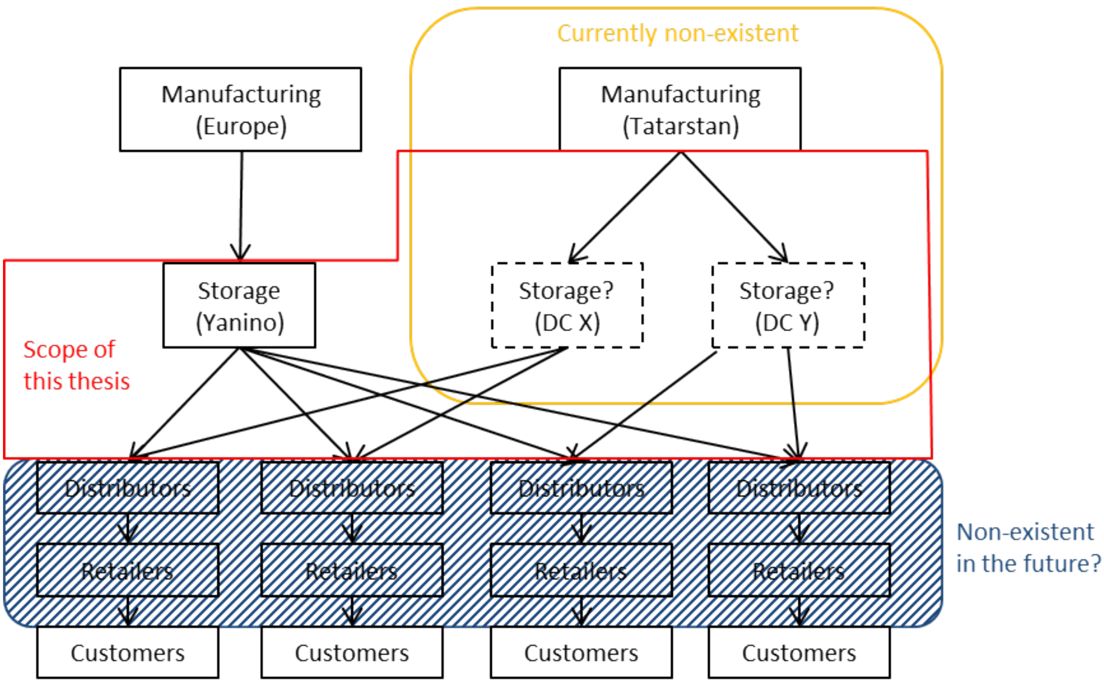


Figure 3.6. A possible, although unlikely, future distribution structure where intermediaries are eliminated.

Although the example is far-fetched, it is a result of the progression that the Uppsala model suggests. Taken even further, the model would also wither the meaning of imported goods, provided that Russia (possibly combined with surrounding countries) is sizeable enough as a market to make in-country production for all SKUs possible, but that has not been speculated in the figure above.

What does the Uppsala model imply for Company X's future operations? Johanson & Vahlne (2009) conclude that an internationalizing company will go "where the focal firm and partners see opportunities." Company X considers the Russian market to be one of its key growth opportunities – especially among the developing markets (Company X 2013c) – and the very fact that a plant is being built in Tatarstan underlines Company X's market commitment.

The question is: Does Company X have enough market knowledge to navigate the market if middlemen are eliminated and the number of direct contacts to customers is increased? There is no absolute answer to this question, at least not one that can be given without the wisdom of hindsight. An answer to the question may not even be necessary as Company X continues its safe, gradual progression. Although the changes caused by the construction of the Tatarstan plant are significant, they do not cause a major point of discontinuity in Company X's market position or its relations to other stakeholders in its supply chain. After all, the plant is the result of a twenty-year gradual development in the market, and it is only one step in a chain of events. It enables further growth opportunities and is another "island" in Company X's leapfrogging strategy to get a foothold on.

The next move after Tatarstan is, in the short term, somewhat irrelevant as the Tatarstan stage requires attention and its success is crucial for the direction taken thereafter. Future, however, must not be disregarded and the scope of this thesis will also allow a safe margin for various future outlooks in the different alternatives. The decision making process related to constructing such alternatives is discussed in the next subchapter.

3.2.2. Distribution decision making process

Already in 1961, Smykay et al. (1961, p. 173) reached the semi-tautological conclusion that "every plant should be located at the point of profit maximization." This is a spectacular observation, but its practical applicability requires closer inspection, as the point of profit maximization cannot be automatically – or uniquely - defined.

When decisions are made on such strategic and capital-intensive issues as distribution channels, the process deserves a more refined systemization and thorough working than mere managerial intuition. Surely, intuition derives always from some sort of experience, and it can yield successful decisions even if its processes cannot be verbalized and validated, but the purpose of this thesis is to offer a proposal which is based on systematical and justified argumentation.

In a market like Russia, the intuitive logic for location selection may be quite solidified and difficult to change. In a research where Finnish companies operating in Russia were interviewed on which federal subjects of Russia are most appealing to them, the four categories of companies interviewed – manufacturing, retail, services and construction –

all had identical answers: Moscow is the most appealing federal subject by a substantial margin followed by Saint Petersburg and Moscow Oblast. Tatarstan – where Company X is building its manufacturing plant – placed fourth after the three dominators in the manufacturing segment and fifth in a combined listing. (Laakkonen et al. 2005, p. 26) This research was based on managerial views and did not specify the logic behind them. Arguments can be certainly found to support the dominance of Moscow, Saint Petersburg and Moscow Oblast, but other alternatives should not be overlooked – especially when the context is like the one in this thesis, where the matter is that of finding possible locations for distribution centers, not subdivision headquarters, for example.

Ashayeri & Rongen (1997) propose a conceptual framework for distribution decisions, which is shown in figure 3.7. It divides the decision making process in to three steps: data collection, optimization and simulation. Once these steps are completed, the results are compared to expectations and satisfaction will lead to implementation, dissatisfaction to a new iteration. The descriptions below the title of each step are specific to Ashayeri & Rongen's model, and they are not applied in this thesis as such.

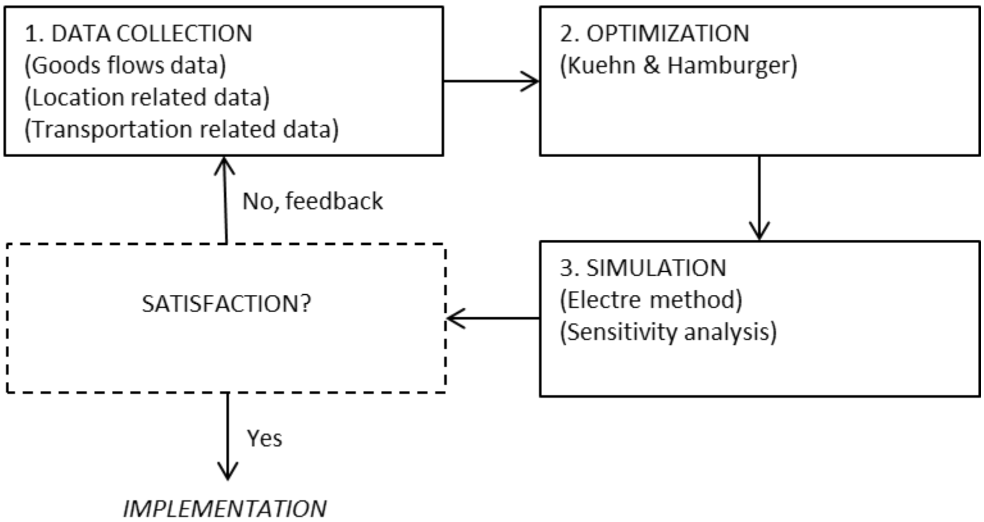


Figure 3.7. A theoretical framework for developing new distribution structures (Ashayeri & Rongen 1997). The different types of data and the optimization and simulation tools are in parenthesis as they are specific to the original study.

In this framework, steps 2 and 3 relate to a quantitative analysis. Nonetheless, the conceptual division in this model is still applicable even if the criteria for decision-making are more qualitative in nature or are based on managerial intuition; some data or information is still needed (step 1) for the decision making process (steps 2 and 3), and the outcome is then implemented or iterated again.

The term optimization may be used loosely in everyday language, but in its strictest definition optimization models "are based on precise mathematical procedures for evaluating alternatives and they guarantee that the optimum solution (best alternative) has been found to the problem as proposed mathematically" (Ballou 2004, p. 647-648). What is noteworthy here is that the optimum solution yielded by the model can only be as good as the mathematical proposition behind it. Simplification of real-life processes is necessary, and mathematical optimization is not always suitable for situations with significant uncertainty. Oftentimes heuristics, or "rule of thumb", models are better suited, since their approximations are far simpler to calculate and yield sufficient accuracy (Simchi-Levi et al. 2003, p. 302). This "sufficient accuracy" of a heuristic model is, of course, only in relation to the solution given by a complex mathematical model, which is also only an approximation. An objective, undisputable optimal solution, if there ever is one, would require the consideration of more variables than any computer can compute or any mind devise.

In Ashayeri and Rongen's model presented in figure 3.7., the difference between optimization and simulation is important. As Simchi-Levi et al. (2003, p. 38) say, "simulation is not an optimization tool." Optimization, whether based on exact optimal solution formulae or simpler heuristics, is a way to find an optimal solution whereas simulation is a means to test the applicability of one chosen configuration (Simchi-Levi et al. 2003, p. 38). Thus sensitivity analysis, for example, will not yield an optimal solution for a problem. It will only test the usability of one alternative. For this reason, Hax & Candea (1984, p. 48) suggest a similar two-step division, where optimization is used to find least-cost alternatives, and simulation is then used to this limited number of candidates.

Instead of optimization and simulation, the criteria that are used in steps 2 and 3 could be called simply decision making, for example, as they vary from one situation to another, and possibilities for these decision making criteria are discussed in the following chapters. The parameters chosen for this thesis and this decision making situation are location selection for distribution centers, logistics costs, lead times and risks.

Ashayeri & Rongen's model includes the possibility of another round of iteration. However, for the purpose of this thesis, there is no possibility for further iteration. While some subchapters and other parts of the process may be iterative in nature, the main outcome of the thesis is provided as the result of a single cycle.

3.2.3. Selection criteria

Quantitative cost minimization is one way to approach distribution decisions, but according to Ashayeri & Rongen (1997), cost minimization is never complete and directly applicable to a real-life situation. They argue that most recent literature utilizes three criteria for final distribution center locations: total transport and location costs, throughput time and a qualitative/quantitative location factor index. These three categories fit the criteria chosen for this thesis: location optimization and transportation mode relate to total transport and location costs, lead times are interchangeable with throughput time and as for a qualitative location factor index, there is risk analysis. The last parameter used in this thesis is sensitivity analysis, which is more of a means to test the other parameters than a separate entity. However, it can also be considered as a quantitative factor index, as different parameters are assessed. The similarities between Ashayeri & Rongen and this thesis are visualized in table 3.2.

Table 3.2. Distribution decision criteria according to Ashayeri & Rongen (1997) and this thesis

<table>
<tr><th colspan="3">Distribution decision criteria</th></tr>
<tr><th>Ashayeri & Rongen (1997)</th><th></th><th>This thesis</th></tr>
<tr><td rowspan="3">Total transport and location costs</td><td rowspan="3">⇔</td><td>Location optimization</td></tr>
<tr><td>Transportation mode</td></tr>
<tr><td>Logistics costs</td></tr>
<tr><td>Throughput time</td><td>⇔</td><td>Lead times</td></tr>
<tr><td rowspan="2">A qualitative/quantitative location factor index</td><td rowspan="2">⇔</td><td>Risk analysis</td></tr>
<tr><td>Sensitivity analysis</td></tr>
</table>

The divisions and criteria used by Ashayeri & Rongen (1997) and this thesis are fairly simple compared to Lorentz (2008), for example, who devises a total of fourteen different criteria (nine quantifiable, five qualitative) for production location selection in the Russian food industry. Even if Lorentz's number of criteria were smaller, the criteria would hardly be applicable to Company X's case as the food and construction industries are definitively different and the criteria are specified to production, not distribution centers.

The criteria listed on the right side of table 3.2. will be described in closer detail in the following subchapters. For location optimization, the load distance-method and the center of gravity are investigated. Other criteria, meaning mode of transportation, distribution and logistics costs, lead times, risks and sensitivity analysis will be discussed in separate subchapters as well. The level of detail and depth of these subchapters varies as some are used more thoroughly in this thesis. Also, some require more explanation than others, as is the case with location optimization, where the method described in literature has fallacies which are corrected for use in this thesis, and those fallacies are described next.

3.2.4. Location optimization: centers of gravity

Other than production facilities and distribution centers, the center of population or other weighted geographic centers have been used historically even to determine the locations of entire capitals of countries. There is even a term, "forward capital" used to denote a capital that is moved to a new location away from existing metropolises to better suit the geographic distribution of population. Possibly the most extreme example of this is the relocation of the Brazilian capital from Rio de Janeiro to Brasília in 1956, when the new capital was built from nothing to sit in the center of Brazil. (UNESCO World Heritage Convention 2013) In a way, Russia is no stranger to this practice, as the main reason for Peter the Great to move the capital from Moscow to Saint Petersburg was to open connections to the west. Although the logic behind this was other than a geographic center – it was that of proximity to the west – the principle of moving away from current population centers is the same. Moscow has since regained its position as the capital, but Saint Petersburg is still the second largest city in the country.

The load-distance method is a means for systematic selection process to evaluate locations based on proximity factors. In brief, the method finds a facility location that minimizes the sum of loads multiplied by the distance the load travels. Other weights, such as time, can be used to instead of or in addition to load size. (Krajewski et al. 2013, p. 119)

Center of gravity is an approximation of the optimal point to evaluate alternatives using the load-distance method. At its simplest, center of gravity can be calculated by the formulae

$$x^* = \frac{\sum_i l_i x_i}{\sum_i l_i} \quad \text{and} \tag{1}$$

$$y^* = \frac{\sum_i l_i y_i}{\sum_i l_i} \quad , \tag{2}$$

where *x* and *y* note the coordinates and *l* the load by which each coordinate is weighted (Krajewski et al. 2013, p. 119). These simple formulae are provided in textbooks such as Krajewski et al. (2013) and Stevenson (2011), which mention that it is an approximation, but they do not stress the fact that in a larger geographic area, the result is nothing short of misleading, as the method ignores the spherical shape of the Earth and only gives adequate approximations for points near each other.

The shortcomings of this method can be easily demonstrated by an example: Calculating the center of gravity for Saint Petersburg (59°N 30°W) and Anchorage (61°N 149°W), the aforementioned equations give the following results:

$$x^* = \frac{59*1+61*1}{1+1} = 60 = 60°N \qquad y^* = \frac{30*1-149*1}{1+1} = -59{,}5 \approx 60°W.$$

This is a point in the ocean somewhere between Greenland and Labrador – some 3300km away from the actual optimal point.

The actual optimal center of gravity *for two points* can be calculated by basic geometrics according to which the shortest distance between them on the surface of a sphere follows the great circle. Thus the point with the shortest distance to the two ends is the center point of the great circle route. (Encyclopaedia Britannica 2013c) Saint Petersburg and Anchorage lie almost symmetrically on the same latitude on the opposite sides of the Earth, and their optimal point is close to the North Pole (90°N).

The difference between the "false" center of gravity based on formulae 1 and 2 and the "correct" center of gravity based on geometrics is visible in figure 3.8. The "false" center of gravity indicated by the red circle is situated on the *average latitude* between Saint Petersburg and Anchorage, whereas the green circle showing the "correct" point follows the great circle, approximately the meridians 30° east and 150° west. Figure 3.8. is drawn on a map centered on the North Pole, which means that great circle route for Saint Petersburg and Anchorage follows a meridian. The map projection serves the purpose perfectly here, as a "regular" Mercator projection distorts the northern parts of the hemisphere greatly and usually cuts out all polar regions above the 85th parallel north (Encyclopaedia Britannica 2013d).

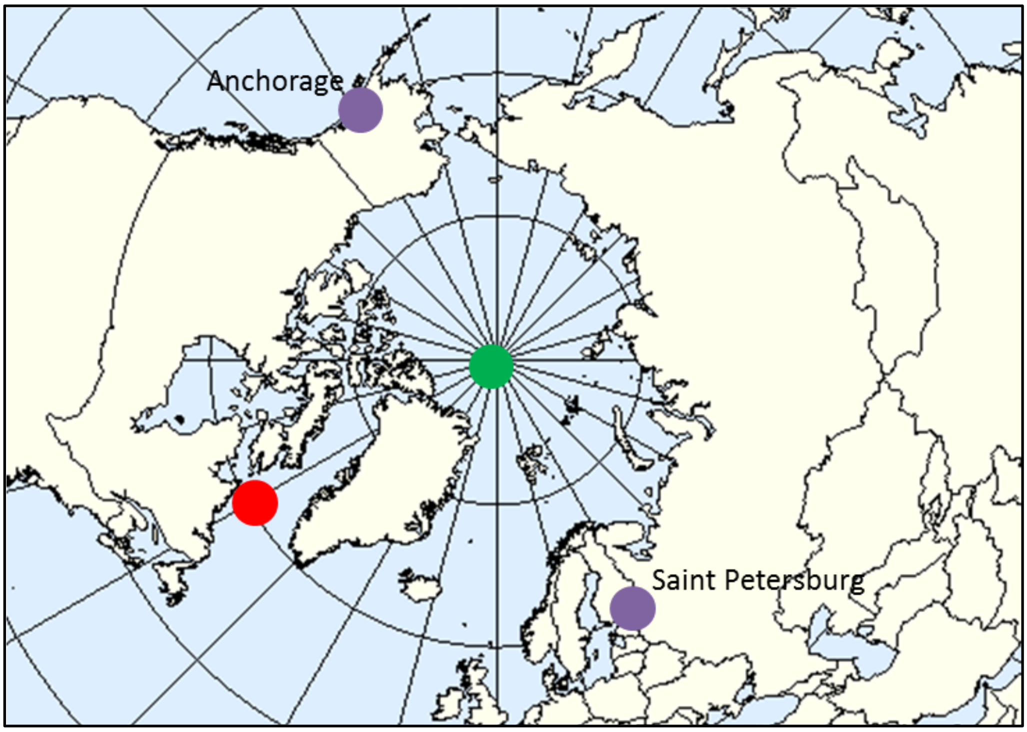


Figure 3.8. An example of center of gravity fallacy. "False" center of gravity in red and "correct" in green. This extreme example was chosen deliberately, and other settings generally yield closer results even with the "false" formulae. (Map base from Wikimedia 2005)

As the figure above shows, the optimal route between Saint Petersburg and Anchorage would pass the North Pole. Crossing the arctic is possible in aviation, but when the relevant means of transportation are roads, railroads and waterways, as is the case in this thesis, such a route would not suite the requirements. Unrealistic routes are not a problem in this thesis, however, since the locations are not as far apart as Saint Petersburg and Anchorage. The farthest great circle distances between the westernmost and easternmost parts of Russia are not realistic considering the road infrastructure in northern Siberia, and they are not used as such – nor are any other great circle distances. Instead, all absolute distances are corrected with a circuity factor, which will be described later. Also, the number of trans-Russian loads forms only a minimal part of all transportation.

In a setting with more than two points, the midpoints of great circle distances cannot be used. For a large number of points, a definitively closer approximation than formulae 1 and 2 can be achieved by converting the coordinates to three-dimensional Cartesian coordinates and calculating the center of gravity for those points. The result is a point in three-dimensional space, not on the surface of the Earth. A point on the surface is then extrapolated following a line from the result point and the center of the Earth. This new surface point is far closer to the optimal point than calculations based on formulae 1 and 2, and the method can easily be applied to any number of points. To find out the exact optimal point would require iterative, labor- and computer time-intensive calculations, which would yield a result only marginally more accurate than the center of gravity for Cartesian coordinates.

For this thesis, the center of gravity for three-dimensional Cartesian coordinates is used, as Russia – being the largest country in the world – is not small enough an area for formulae 1 and 2 to provide sufficient accuracy. Of course, road and railroad networks affect the actual routings of transportation, and no roads follow great circles between two points. Nevertheless, using a method that provides more accurate results for an idealized situation is also beneficial for real-world applications.

Actual road distances can be approximated by multiplying the great circle distances by a circuity factor. A circuity factor is a constant that is calculated by dividing the actual road distance between two places by their great circle distance. (Simchi-Levi et al. 2003, pp. 32-33) An example of this is given in figure 3.9.

Figure 3.9. Circuity factor for the distance between the Tatarstan plant (A) and a Company X distributor in Moscow (B). "Great circle" is in parenthesis as it is represented by a straight line - not an actual great circle route, which would curve slightly in a Mercator projection. (Map base from Google Maps 2013)

In the figure above, the circuity factor for the distance between the Tatarstan plant and one of Company X's distributors in Moscow is 1.20. Basic geometrics state that a circuity factor cannot be less than 1.00 (without traveling through the Earth's interior), since the great circle distance *is* the shortest distance between two points.

For Russia, Ballou et al. (2002) calculate the circuity factor for Russia to be 1.37 with a standard deviation of 0.26. The average circuity factors in the study vary from 1.12 in Belarus to 2.10 in Egypt. No explanations are given, but one could speculate that Belarus is geographically ideal for roads with no mountains, major bodies of water or other curvatures whereas the road network in Egypt is greatly influenced by the distribution of population along the banks of the Nile. Russia, of course, has great variations between different parts of the country, and the aforementioned value 1.37 is only an average for entire Russia.

The reason why a circuity factor is used instead of actual road distances is the number of nodes involved. If road distances were calculated individually between each of the 83 federal subjects of Russia, thousands of separate routings on applications like Google Maps would have to be made. By using coordinates, a spreadsheet program can easily do the calculations, which are then multiplied by the circuity factor.

3.2.5. Mode of transportation

The four basic modes of transportation are air, rail, road and water. Pipelines can be considered to be the fifth mode, but their usability is limited to vast amounts gases and liquids, not suspended ceiling systems. The main differences between the different transport modes can be seen in figure 3.10. The numbers are conceptual and extremely crude. Thus they should not be taken literally.

Accessibility
Air requires delivery transportation
Road reaches everywhere (save overseas)
Rail requires delivery transportation
Sea requires delivery transportation

Capacity	
Air	1 ton
Road	10 tons
Rail	100 tons
Sea	1000(00) tons

Cost	
Air	1000x
Road	10x
Rail	10x
Sea	1x

Speed (Helsinki-Oulu)	
Air	1 day
Road	1 day
Rail	2 days
Sea	4 days

Figure 3.10. Conceptual differences between transportation modes (adapted from Liimatainen 2012)

Figure 3.10. addresses accessibility, capacity, cost and speed as essential parameters, but arguably environmental impact could be mentioned, too. Through economies of scale, sea freight in containers is oftentimes the most environmental alternative, whereas airfare tends to be the most harmful. Pollution and other environmental parameters, however, are not singularly defined, and different transportation modes have different levels of different types of emissions. For example, sea freight has disproportionately high sulfur dioxide (SO_2) emissions even though its carbon footprint may be the lowest.

Currently, Company X uses sea and road for the transportation for the goods sold in Russia; the goods arrive to Saint Petersburg by ship and are carried on trucks from there on. This is the main transportation route, but some individual retailers and distributors come to collect their loads with their own trucks from the European manufacturing plants and drive them to Russia. Next, the availability and viability of the different modes of transportation in Russia is discussed briefly.

Airfare would be almost as far-fetched as pipelines, as the products have low value-to-weight and value-to-volume ratios, and, being the most expensive transportation mode by far, airfare should be saved for critical, urgent specialty deliveries at most.

Railroads, the Trans-Siberian Railway in particular, have traditionally had a vital role in Russia, and the infrastructure is extensive. During the Soviet era, planners placed great emphasis on industrial production, leading to immense tonnages of coal, iron, steel and construction materials being produced. The size of the country and its harsh climate prevented highway construction and restricted the role trucks and barges could play. Thus the logical option was to develop the railroads to a far greater extent than in other economies. The fall of the Soviet Union reduced railway transport by 60% between 1988 and 1998 hindering maintenance and development greatly, but railroads still form the backbone of freight in Russia: 80% of Russia's surface tonnage-km is carried on railways compared to 40% in USA, Canada and China – and Russia carries more freight on rail than all of Western Europe put together. (Belova & Thompson 2005) The problem with Russian railways is speed: the average freight train moves at a speed of 37km/h, and when stops at stations are added to this the average speed is only 10km/h (Kosonen et al. 2012, p. 25).

Road transportation in Russia is specialized to short distances to complement the railroad infrastructure. The density of the road network is low and has increased slowly in the 21st century. A more developed network is needed in order to achieve the wanted economic growth, but that would require massive investments. (Pekkarinen 2005) These problems affect a company like Company X less as the freight moves between a fixed number of nodes, namely distribution centers and warehouses. The situation is completely different for a dairy company, for example, which would have to make repeated visits to remote places on lower-priority parts of the road network.

Sea transportation in Western Russia faced great challenges after the fall of the Soviet Union as important ports such as Tallinn, Riga, Ventspils, Liepaja and Klaipeda were lost to other former Soviet countries (Pekkarinen 2005, pp. 66-67). The Baltic Sea still remains Russia's most important waterway, and the capacity at Ust-Luga is being doubled with investments to new oil and container terminals (Kosonen et al. 2012, p. 24). The Baltic Sea, however, is not Russia's only waterway, and many of its largest ports are situated by the Black Sea, the Sea of Japan or the Barents Sea. (Pekkarinen 2005, p. 67) Seaports play a minimal role in domestic transportation, since Russia does not have a continuous coastline like Norway, for example. For domestic transportation, inland waterways are more significant, and Russia has the longest inland waterway system in the world, which is underused. Inland waterways are naturally limited to where the rivers flow – usually south to north – and another problem with the inland waterways of Russia is that they are frozen 3-8 months per year prohibiting any transportation (Kormyshov 2005).

A combination of different modes of transportation can be used, and as figure 3.10. indicated, air, rail and sea transportation always require at least some road transportation. A common practice is intermodal transportation, where the freight remains in the same container (or other larger shipping unit) through the different transportation modes without its contents being altered (Roso 2008).

An intermodal transportation alternative that could be relevant to possibilities offered by the extensive Russian railroad system and Company X importing its products is the dry port. A dry port is a concept where a seaport is directly connected with inland intermodal terminals, usually by train. This means intermodal loading units can be treated as if the dry port was a seaport (Woxenius et al. 2004). The benefits of a dry port, however, are those of relieved seaport terminal congestion and better seaport inland access (Roso 2008), which are currently not significant problems to Company X. Also, one key issue in developing a distribution model for Company X is that the load should be handled as little as possible to avoid damages to it. This, of course, is not that substantial even in a dry port arrangement since the containers are handled without unloading and reloading them between transportation modes. What is problematic, however, is the unavailability of railroad transport to the Moby Dick container terminal on Kotlin Island. Thus the containers would have to go through road transport just to be loaded on a train.

The infrastructure for different transportation modes in Russia can be seen in figure 3.11.

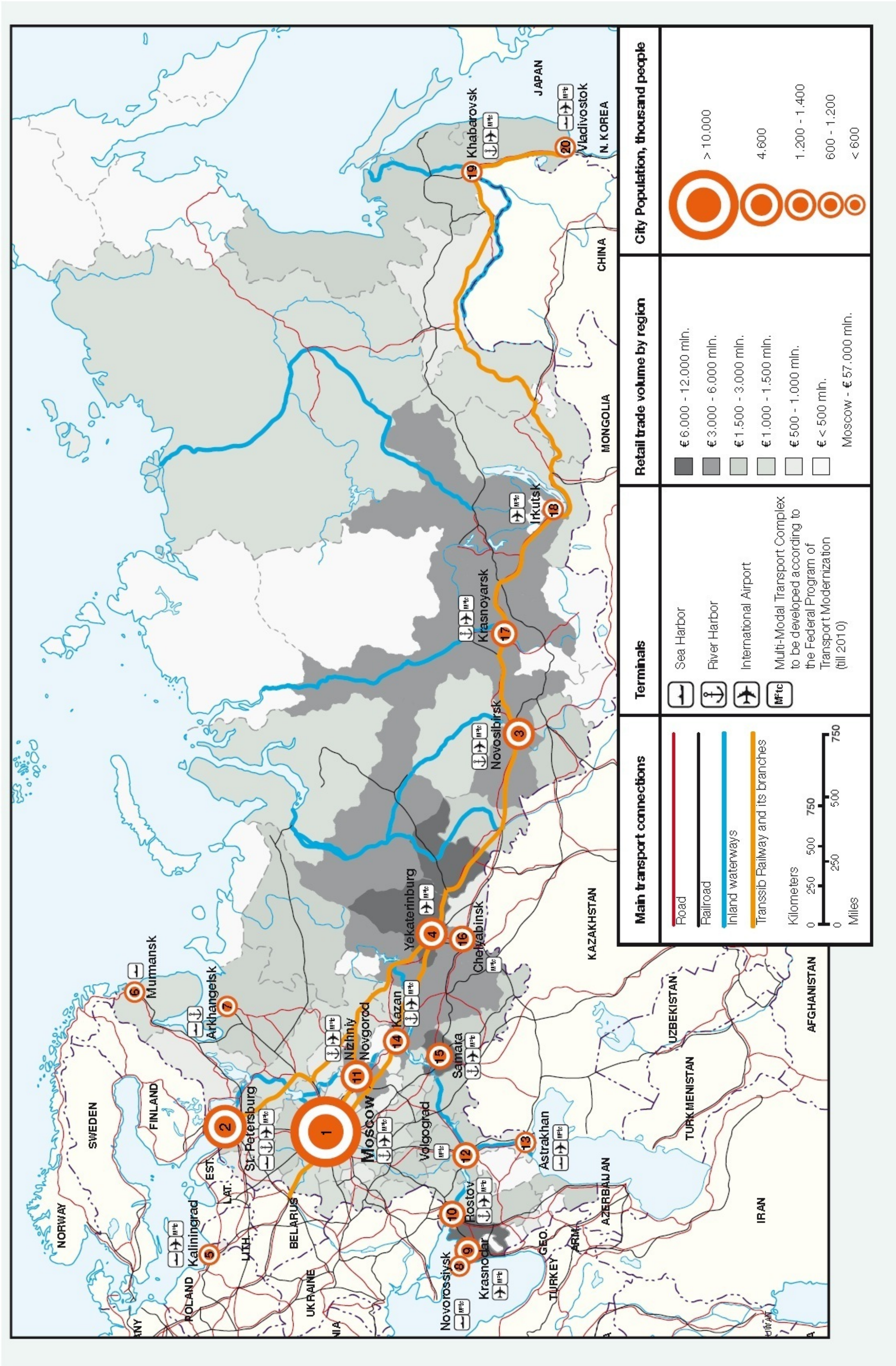


Figure 3.11. Logistics map of Russia (Capgemini 2007)

As figure 3.11. indicates, there are great differences between the different transportation modes. The main railroad line – the Trans-Siberian Railway with its branches – runs east to west whereas the inland waterways run mainly south to north with the exception of the curving Volga route. Roads have more versatility in comparison to railroads and inland waterways. The map also portrays the distribution of population in Russia with most of the larger cities situated west of the Ural Mountains and the rest being situated along the Trans-Siberian Railway. Shades of gray represent the value of retail trade by region. This is not directly relevant to Company X as its products are not sold in the residential segment in Russia, but retail volumes are also descriptive of the development and *modernization* – as Russians tend to put it – of the region, which also generates sales in the commercial segment.

The map in figure 3.11. can only show the main principles of the transportation infrastructure as it attempts to fit information on transportation infrastructure, demographics and retail volume on a single map of the largest country on Earth. As with all other maps, the size of the country distorts the information on the map. Arguably, a map of Russia cropped to show only the parts west of the Urals would add to the understanding of the Russian transportation infrastructure even if it ignored Asian Russia, since the density of population and transportation networks in the west is so high compared to the space it occupies on a map of Russia.

3.2.6. Distribution and logistics costs

Logistics costs and distribution costs are used interchangeably in literature, but in their narrowest sense, distribution costs should only be limited to outbound logistics, although in-house logistics are often included. The term “logistics costs” implies the inclusion of a wider range of different costs. For this thesis, logistics costs are addressed generally, but the focus is mostly on distribution costs, especially on transportation costs.

Logistics costs can be categorized in a multitude of ways. One categorization is given by Ballou (2004, p. 14), who divides logistics costs to five categories, which are

1. transportation,
2. warehousing,
3. customer service/ order entry,
4. administration and
5. inventory carrying costs.

This division can be visualized in different ways, and more categories can be named. For example, the Ministry of Transport and Communications of Finland (2012, p. 18) develops similar categories named by Ballou even further and proposes a 2x2 matrix which can be seen in figure 3.12.

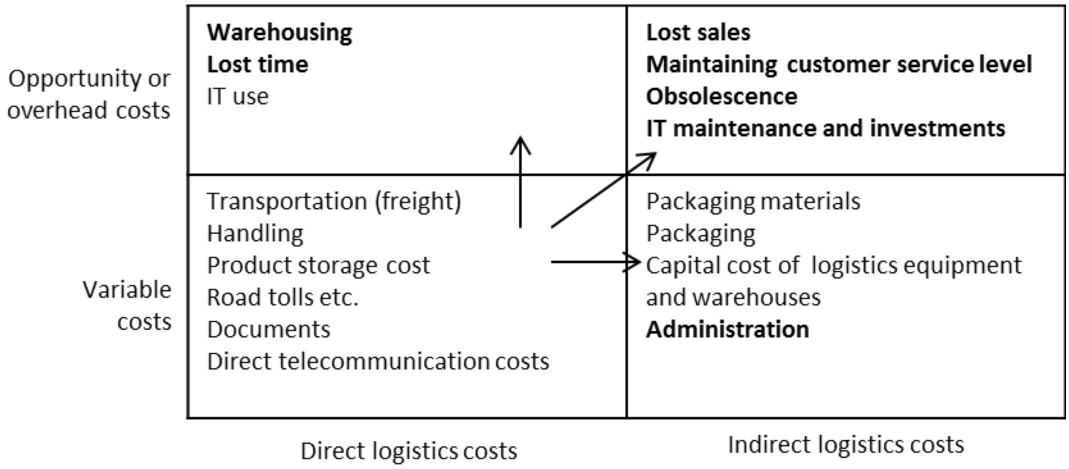


Figure 3.12. Logistics costs (Ministry of Transport and Communications of Finland 2012, p. 28)

The matrix in figure 3.12. divides costs on the X-axis based on their being direct or indirect, and Y-axis shows variable costs and opportunity or overhead costs. It also lists more categories compared to Ballou. The arrows and bolding underline the importance of indirect and/or opportunity costs in a situation where competition is increasing. The measuring of these costs is also more complicated as costs related to lost sales or maintaining customer service level, for example, are not singularly defined.

Regardless of the different divisions, the three components of logistics costs that cannot be disregarded are the cost of transportation, cost of warehousing and the cost of inventory. These are inarguably caused by logistics whereas the costs of customer service and administration proposed by Ballou (2004) or the numerous other components listed by the Ministry of Transport and Communications of Finland (2012) are based on cost calculations richer in their details and higher in their level of abstraction.

Logistics costs may be difficult to define for a single company, and national estimations are even more obscure. In a macro level, there is no definite singular way to calculate logistics costs as there is no standard for such calculations among companies or nations (Ministry of Transport and Communications of Finland 2012, p. 48). Different estimates exist, and according to an econometric model by Rodrigues et al. (2005), logistics costs account globally for 13.8% of the world's GDP in 2002. The percentage varies between different countries from 9.3% in the United States to 17.9% in China. There is a clear correlation between the income level of a country and its logistics expenditure, as the average is 17.4% for low-income countries and 11.3% for high-income OECD countries. (Rodrigues et al. 2005) All in all, logistic costs are costly to the global economy, and any attempts at lowering them may yield great savings.

In addition to logistics costs, Company X pays 20-30% import duties on its products in the Russian market (Company X 2013c), but logistics costs are high even for companies that do not import their products. Logistics costs constitute 20-25% of the turnover of Russian companies, which is twice the amount of that for Finland (Tuominen et al. 2009). Company X estimates its logistics costs to be 30% of landed costs in Russia and uses the term “very high” to describe them (Company X 2012b). Another issue concerning logistics costs is the fact that warehouses are in short supply in Russia, as the demand for modern warehousing facilities is bigger than the supply. The problem is not caused by the lack of investors but by the lack of suitable land plots at the outskirts of large cities and bureaucracy and corruption in the application processes for building permits. (Louhivuori 2006, p. 70)

3.2.7. Lead times

A lead time is, in its most general meaning, “the elapsed time between the receipt of a customer order and filling it” (Stevenson 2011, p. 52). Thus it differs from a throughput time, which refers to the total time taken from the beginning of a process until it is finished (Stevenson 2011, p. 259). Lead times are a more customer-oriented concept, and they describe the time customers have to wait for their orders to be filled, whereas throughput times are used to examine production or other supply chain processes from an efficiency point of view.

In a demand-driven or customer-driven supply network, the importance of lead times is tried to circumvent by emphasizing the availability of almost real-time information on end-customer demand. Thus the bullwhip effect, which means the fluctuation of demand growing upstream in the supply chain, is diminished. (Mendes 2011, p. 5) When information is available on all echelons, the entire supply chain becomes more agile thus resulting in the same benefits that could be won by short lead times. However, a demand-driven supply network requires close coordination of the entire supply networks and transparence in its working. All parties involved must be committed to it and the internal activities within the different companies must be tightly integrated and information must be exchanged swiftly both upstream and downstream in the supply chain (Hadaya & Cassivi 2007). This is something that cannot be tackled in this thesis, and considering it will be left for higher strategic decision making.

Considering the scope of this thesis, the relevant aspect of lead times is that of products being delivered from manufacturing or storage to distributors, and this affects the overall lead time experienced by the end-customer, if the distributor does not have the ordered products in stock. However, lead times are a result of the entire supply chain. Thus the examination of lead times would require access to the planning of the supply chain as a whole, and that is not possible within the scope of this thesis. Thus it suffices to say that in an optimal situation, and in a situation where the process of planning a distribution model were part of the entire corporate planning process instead of being limited to a master's thesis, lead times would be an important factor. Also, assessing them would give enough material for a multitude of other theses.

3.2.8. Risks

Risks are omnipresent in the business world ranging from financial to environmental, safety and security or political risks, for example. The intuitive solution may be to avoid risks by removing them altogether, but other ways to manage risks exist as well: the risks can be reduced, transferred or a combination of these three can be used (Stevenson 2011, p. 669). Avoidance means giving up or not participating in the risk such as entering a dangerous market. Risk reduction may be, for example, providing workers in a dangerous process with improved safety equipment. Transferring the risk would be outsourcing this dangerous part of the process to an external supplier, who would in turn be carrying the risk and most likely adding the costs of this risk to its pricing.

Risk management starts with identifying risks. As the magnitude of a risk is the product of its likelihood and impacts, these two are assessed then, after which aforementioned risk management strategies are used. The process is visualized in figure 3.13.

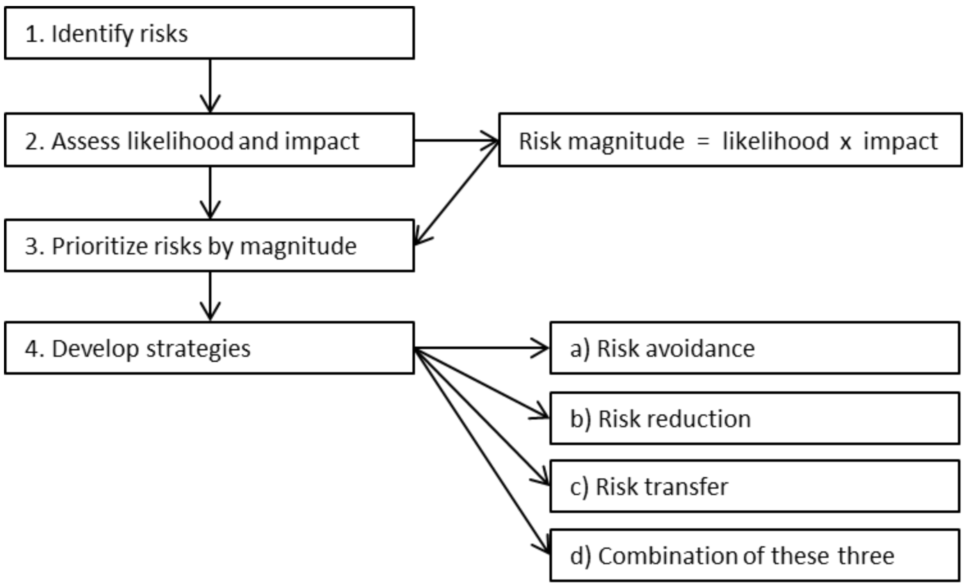


Figure 3.13. Risk management (adapted from Stevenson 2011, p. 668-669)

In a situation like this thesis, many risks vary from one alternative to another. Say, the possibility of stocking out is lower if two independent inventories are carried at separate distribution centers as opposed to having just one distribution center. Thus risks are analyzed separately for each alternative.

An effective means to produce summative information on risks is to perform a SWOT analysis, which is a tool widely used to assess the strengths, weaknesses, opportunities and threats of each alternative. SWOT per se does not address the likelihood or impact of a given risk (meaning weakness or threat), but it does list them. A separate analysis on the likelihood and impact can be made and strategies to diminish the risks developed.

3.2.9. Sensitivity analysis

A proposal for a distribution model such as the one provided in this thesis or for another business function is always created with a certain forecast for the future in mind. Reality tends to differ from forecasts and the three rules of forecasting by Simchi-Levi et al. (2003, p. 49) should not be forgotten:

1. “The forecast is always wrong,
2. the longer the forecast horizon, the worse the forecast and
3. aggregate forecasts are more accurate.”

For Company X’s demand forecasting, aggregation cannot be avoided since specific end-customers are not known. Thus the demand generated by a single end-customer is automatically aggregated to the distributor’s distribution center from which the end-customer gets the goods, and these distributor locations are the last nodes in the known supply network. Regardless of the accuracy of a forecast, sensitivity analysis is an effective means to test volatility in the parameters forecasted.

Sensitivity analysis can be seen both as a tool to test the effects of volatility to a given system and as a way define the limits and the probabilities for the volatility of the parameters that still yield the desired level of profit, for example (Stevenson 2011, p. 220-221). For this thesis, sensitivity analysis is used in the former sense: the changes in the parameters – or even the actual parameters – are not chosen and treated to the extent where they would exhaustively define limits for acceptable changes. Rather, the sensitivity analysis is conducted as individual parameters causing a singular ceteris paribus effect, and exhaustiveness is not pursued considering the scope of this thesis.

The parameters chosen depend on the situation, and they can vary based on what is relevant to the decision making situation. Ashayeri & Rongen (1997) mention that, in location decisions, changings costs, volumes and throughput times as parameters that should be examined in the light of sensitivity analysis. In a production facility decision making situation, Yang & Lee (1997) consider labor cost and business climate as the key parameters. These two, however, may not be as relevant to a distribution model. What is interesting in Yang & Lee’s (1997) paper is their mentioning of “managerial priority shifting among factors under consideration.” This is a reminder that sensitivity analysis is not only numerical as it requires human prioritizing for actual decision making especially when the parameters cannot be expressed in numbers – and this prioritization may change over time.

4. RESEARCH METHODS AND MATERIALS

This chapter describes the alternatives developed in this thesis and the criteria (or parameters) used to assess them. The principles of the alternatives are described in subchapter 4.1. The alternatives were originally proposed by a representative of Company X, but this was in most part a proposal as to the number of the distribution centers and some of their locations. The alternatives, however, have been developed further thereafter, and their qualitative assessment and giving each alternative a summative function (such as the base case being described as "Convenient for Company X") is already a *result* of the thesis, even though they mentioned in this chapter. After the presentation of the alternatives, the criteria are explained in their own subchapters.

This chapter serves as an explanatory warm-up for the results in chapter 5, where the alternatives are developed and assessed in detail. Thus the descriptions the alternatives in subchapter 4.1. are based mainly on the number and locations of distribution centers, and transportation modes, for example, are left for the following chapter.

4.1. Alternatives developed

This subchapter introduces the basic principles of the alternatives that will be developed in this thesis. As an introduction and a point of comparison for the upcoming graphic presentations of the different alternatives, the current distribution model is shown in figure 4.1. The Urals have been marked in this figure and the following figures to show some indication of the geography of Russia and how each distribution solution fits it.

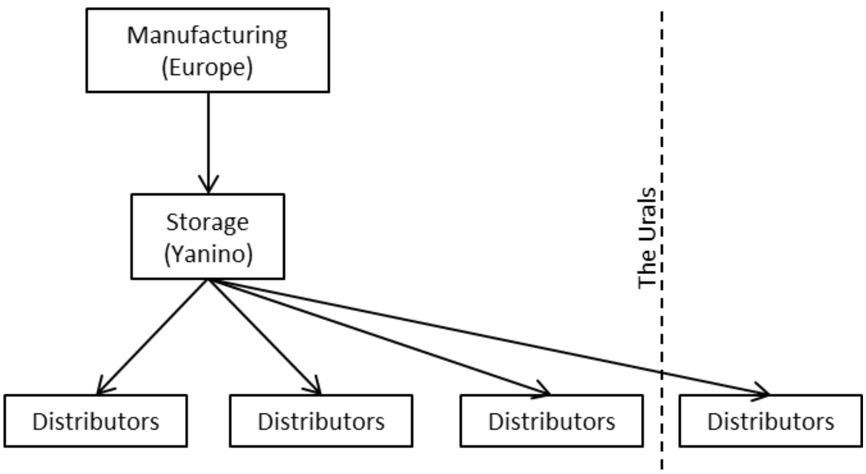


Figure 4.1. The current situation visualized.

The figure shows that the distribution model currently deployed in Russia is quite simple. It consists of one incoming flow to Saint Petersburg whence the goods are carried out to distributors – and the transportation is done by the distributors themselves. In all of the alternatives described next, the complexity grows, but that is inevitable considering the completion of the Tatarstan plant. Also, complexity is something that Company X is pursuing indirectly, as the distribution model is gravitating away from ex works distribution to transporting the goods directly to the distributor.

4.1.1. Base case: Commodity DC in Tatarstan, another DC in Saint Petersburg – "Convenient for Company X"

The base case is to start a commodity distribution center in Tatarstan while having another distribution center in Saint Petersburg ergo continuing the operations at Yanino. This means that the higher-end products imported from Europe will be stored in Yanino and the commodity goods produced in Tatarstan will pass through the Tatarstan distribution center. The conceptual division is visualized in figure 4.2.

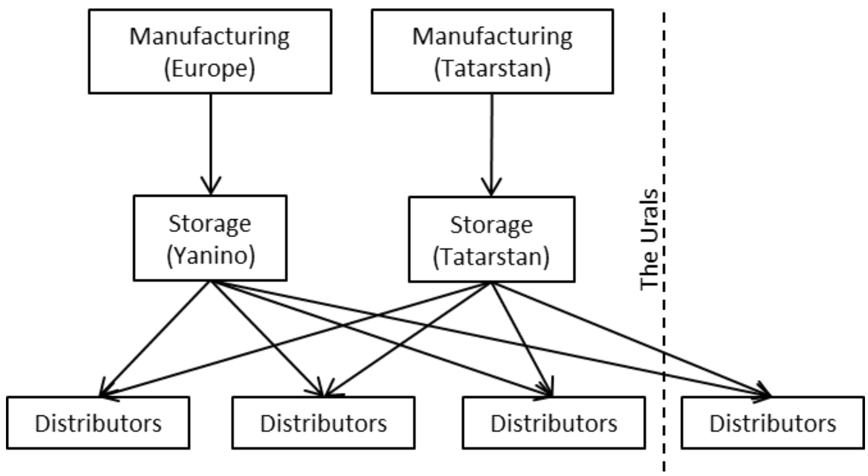


Figure 4.2. Visualization of the base case

This alternative is named "Convenient for Company X" as the Yanino location already exists and the Tatarstan location will be near the plant. Thus no new or remote distribution center locations are needed. The disadvantage is, of course, that the distributors have to haul the products they need from two different locations.

4.1.2. Alternative 1: One DC – "Simple for everyone"

Alternative 1 includes just one distribution center which handles both imported products and the products coming from Tatarstan. The location for this distribution center was not specified by Company X, and the location will be determined in chapter 5. Tatarstan serves as a starting point for the location of this distribution center, since it is also – as will be shown in the results chapter – the center of gravity for different demographic indicators in Russia. Thus Tatarstan is mentioned in the structure of this alternative shown in figure 4.3.

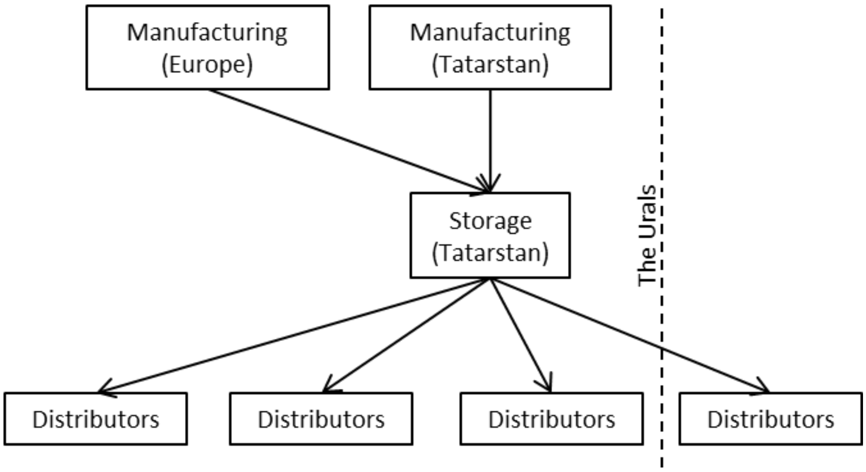


Figure 4.3. Visualization of the one-DC alternative 1

As can be seen from the figure, the alternative is logistically quite straightforward, as there is only one possibility for the flows of materials. Surely a direct link between manufacturing or importing and distributors is possible as well, but such possibilities have not been marked in this conceptual figure, nor are they marked in the other alternatives.

This alternative is "Simple for everyone" as there is only one distribution center; it is convenient for Company X to operate and the distributors get all of their products from the same distribution center. Although Tatarstan serves as a starting point for the distribution center, arguments can be made to place it near Moscow as well, since the majority of products go to distributors based in or near Moscow. This will be described in more detail in chapter 5.

4.1.3. Alternative 2: Two DCs – "Convenient for customers"

Alternative 2 includes two distribution centers. This number of distribution centers was predetermined by Company X, but their locations and functions were not. As it was with the previous alternative and Tatarstan, in this alternative, Moscow and Novosibirsk serve as starting points for the locations of the distribution centers, since they are centers of gravity for European and Asian Russia, respectively. However, they are only starting points; although Moscow is a strong candidate on all parameters, having Novosibirsk as the eastern location would be overly optimistic.

As the number of nodes increases, a multitude of different possibilities could be drawn for the flows of products both upstream and downstream from the distribution centers – and between them. However, this has not been done in order to keep the figure simple.

As with the other alternatives, alternative 2 will be developed and assessed in more detail in chapter 5. Alternative 2 is visualized in figure 4.4.

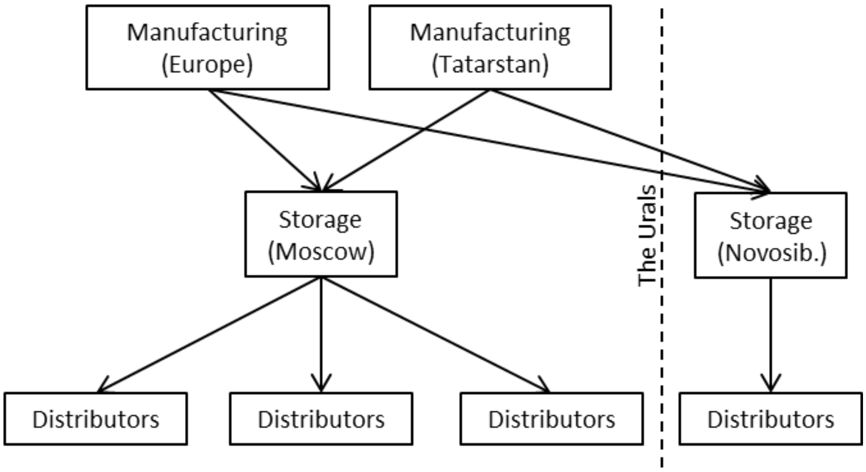


Figure 4.4. Visualization of the two-DC alternative 2

This alternative is "Convenient for customers" since each distributor (customer) is served by one distribution center, and the distribution centers are situated as close to the distributors as possible. Also, if Company X pursues a business model where it delivers the products to distributors or even end-customers, this alternative results in lesser transportation costs and better lead times. Thus it suits also a more far-sighted strategy.

4.1.4. Alternative 2 mix: Three DCs – "A vision for the future"

Alternative 2 can be varied and combined with the base case. The reason for this is combining the best sides of both: in light of demographic data, the combination results in lower lead times and lower total ton-kilometers, but its downside is the added costs and complexity of operating three different distribution centers. In this variation, distributors west of the Urals are served by two distribution centers, and distributors east of the Urals get the products from one distribution center. This is shown in figure 4.5.

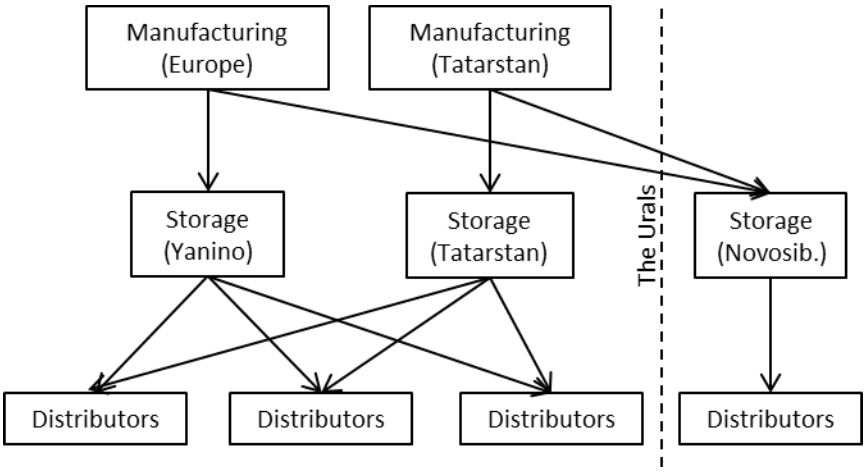


Figure 4.5. Visualization of another variation of alternative 2

The reason why this is called a variation of alternative 2 instead of a variation of the base case is that it includes a distribution center far beyond the Ural Mountains. This would be something of a leap of faith on behalf of Company X, as it would be a more far-sighted solution relying on growth and opportunities in the parts of Russia that lie east of the Ural Mountains. The Uppsala model discussed earlier in the thesis stressed the fact that a gradual step-by-step approach is one adopted by companies that are risk-averse, and that has been Company X's approach in the Russian market.

Placing a distribution center so far east would require risk-taking, and the viability of this option is discussed in more detail in the next subchapter. In fact, this alternative is viable only based on demographic data and high prioritization of low transportation distances over the operating costs of three distribution centers. As will be shown in the next subchapter, this variation does not prove effective in light of actual sales data, and it will be excluded from the alternatives in chapter 5.

4.1.5. Why the different alternatives?

The benefits of having more than one distribution center – or positioning the only distribution center at a location other than the manufacturing plant – are those of improved lead times and cut ton-kilometers. Operating more distribution centers naturally results in added costs, and finding an optimal solution requires finding a balance between these trade-offs. Of course other factors affect the benefits of all alternatives. Alternative 1 with only one DC, for example, has the benefit of being able to consolidate truckloads of products from both Europe and Tatarstan manufacturing. This simplifies the process, but it comes at the cost of unnecessary back-and-forth transportation. These benefits are discussed in more detail in the next chapter, chapter 5.

The principles of the different alternatives are visualized in figure 4.6.

Figure 4.6. Visualization of the different alternatives. The amount and destinations of the red outbound arrows are symbolical and do not represent actual end nodes, as is the thickness of all arrows. (Map base from Wikimedia 2007)

In the figure, each alternative is shown on its own map of Russia, where blue arrows show the flow of materials entering a distribution center, manufacturing plant or terminal, which are all symbolized with red dots. Red arrows indicate outbound transportation to distributors. The width of the arrow roughly estimates the amount of materials transported. The configurations shown in the figure are merely starting points for developing the alternatives, and some changes will be made to them later on in the thesis.

As the figure indicates even in its rough simplicity, all of the alternatives that do not include a distribution center east of the Ural Mountains include “long arrows” meaning lengthy transportation to distributors there. This is currently at its height as all goods are imported through Saint Petersburg – one of the westernmost corners of Russia.

The principle load-distance differences between the alternatives are visualized in figure 4.7., which shows the relative total ton-kilometers of each alternative based on four different sets of data. As all data is gathered from external sources, and the exact locations for the Moscow and Novosibirsk DCs in the calculations are based on the unweighted centers of gravity for distributors that Company X lists on its external website. The value of the graph is in showing that although the different alternatives (each wider column) show differing results, the results are still similar regardless of the data source (narrow columns).

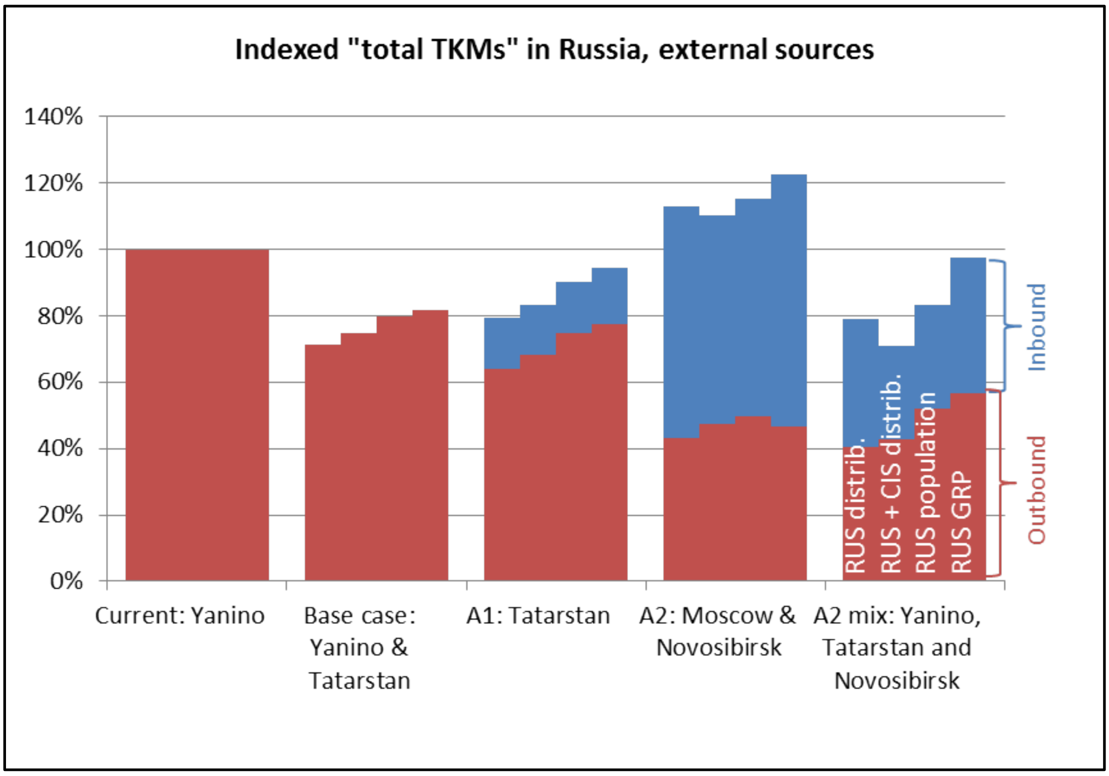


Figure 4.7. Indexed comparisons of the "total TKMs" in Russia of the alternatives

The graph shows inbound and outbound transportation. The figure is drawn from the point of view of distribution centers showing only traffic within Russia. Thus, in the current situation, no inbound transportation is added since the materials are coming from outside of Russia. Equally, the base case includes no inbound transportation, because the materials are either made on location (near the distribution center at the Tatarstan plant) or imported. What is relevant is who the "owner" of these transportations is. Inbound transportation (in blue) is paid for and organized by Company X, but outbound transportation (in red) is defined by the future business model of Company X. If the products are sold on an ex works basis, the amount of outbound transportation is irrelevant to Company X when costs are considered, and minimizing it is mainly a service element to its customers. However, if the products are delivered to customers, minimizing outbound transportation is also financially in the best interest of Company X.

Each wider column in the figure contains four narrower columns representing a set of data. From left to right, these sets of data are: Company X's externally listed distributors in Russia, Company X's externally listed distributors in Russia and other CIS countries, Russian population and Russian gross regional product (GRP). As GRP and population give weighted scores based on the number of federal subjects (which is, of course different from Company X's distributors), all sets of data have been indexed based on the current situation to make them comparable. Thus the figure is not an indicator of absolute ton-kilometers; it merely shows approximations of the relative portions of each alternative.

The calculations in the previous figure are not based on final locations of each alternative, which will be determined in chapter 5; the locations for the distribution centers near Moscow and Novosibirsk based on the centers of gravity for current Company X distributors in Russia. Thus they result in some non-optimal routing. Yekaterinburg, lying barely east of the Urals, for example, is allocated to be served by the Novosibirsk cluster distribution center in the last two alternatives even though it is much closer to Tatarstan. If Yekaterinburg and other surrounding distributors are allocated to the "western market", the locations of the centers of gravity move, and iteration is needed. These are matters that will be developed more when the alternatives are discussed individually in chapter 5.

The figure shows that all alternatives except alternative 2 have lower total ton-kilometers than the current situation. This difference is even more significant when the transportation between Europe and Yanino is considered, as 80 % of the volume will be produced in-country, meaning an 80 % drop in transportation between Europe and Yanino.

The difference between total ton-kilometers and outbound ton-kilometers is also substantial between the alternatives, as the outbound ton-kilometers are what affect lead times in a system where products are delivered to customers as oppose to an ex works arrangement. Thus alternative 2 may have a significantly higher portion of total ton-kilometers, but its outbound transportation is much smaller than the base case and alternative 1 – and especially lower than the current situation. Again, this is a matter of prioritizing, and it is clear that shorter lead times can be "bought" with higher transportation costs and investments in more distribution centers. The mixing of the base case and alternative 2 combines the main benefits of the two – meaning low total ton-kilometers and low outbound kilometers – but this variation requires a total of three distribution centers, which means more investments and complexity in the distribution network.

The results in figure 4.7. showed results based on demographic and unweighted external Company X data. When actual sales numbers are added, the results are yet again markedly different as a result of Company X's largest distributors being Moscow-based. The results are shown in figure 4.8., where calculations based on actual sales numbers are added in darker hues.

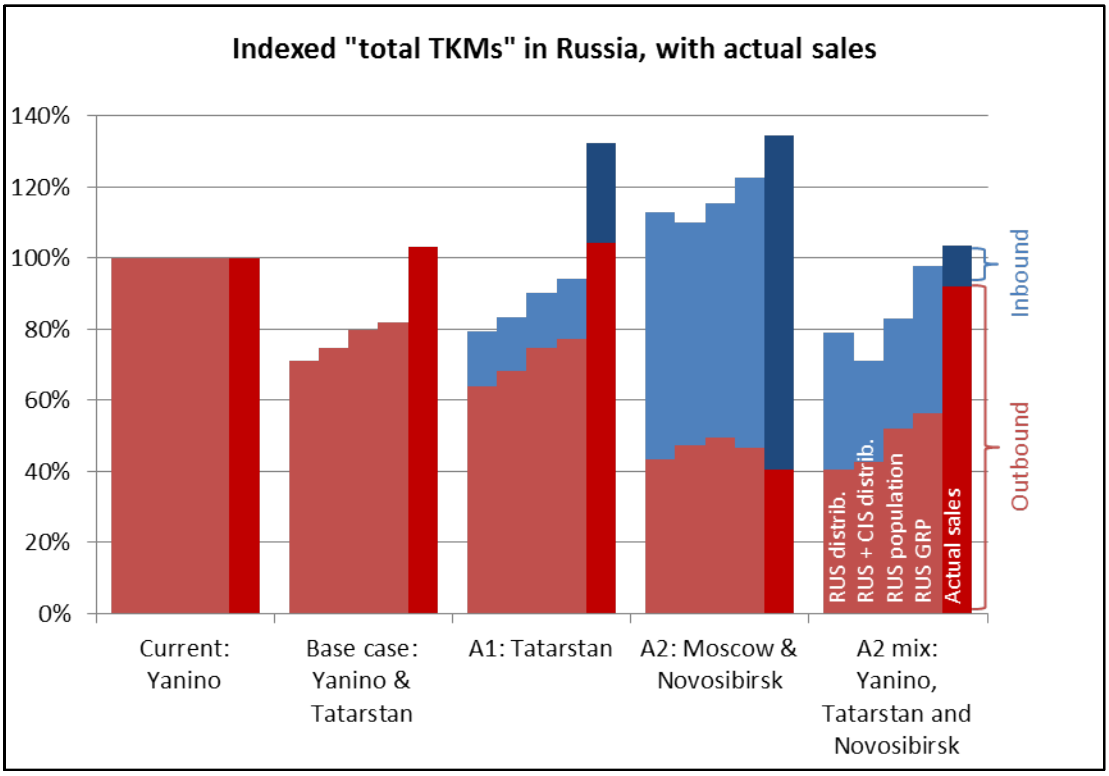


Figure 4.8. Indexed comparisons of the "total TKMs" in Russia of the alternatives including actual sales numbers in darker hues.

The effect of the concentration of distributors in Moscow is evident in the last narrow columns which are calculated based on real sales data. This is particularly clear in the last alternative, which was created as an attempt to combine the benefits of alternative 2 and the base case. In the light of actual sales data, this alternative, which includes the most distribution centers and complexity, performs poorly because it *does not include a* *distribution center in Moscow*. Instead of combining the benefits, it combines the disadvantages of the other alternatives. The same applies to the base case and alternative 1, but alternative 2 shows similar results to the four other sets of data – because it includes a distribution center in Moscow. Since the Moscow distributors have such an immense effect on the outcome of the calculations, moving the single distribution center in alternative 1 from Tatarstan to Moscow is also something to be considered, if the importance of outbound transportation is valued either as a service element to customers or as a means to have lower delivery times and shorter distances to customers if Company X starts to deliver the products to customers. This will be discussed in the results chapter.

The title of this subchapter asked: Why the different alternatives? The obvious answer would be to conclude that these were the alternatives proposed by Company X, but that would be only half the truth. Company X only defined the principles of these scenarios, but their locations (in relation to the Urals, for example) and the variation of alternative 2 are something that has been developed already during the process of this thesis, although the variation of alternative 2 will be excluded from the alternatives in chapter 5. At this point of development, figure 4.8. showed the clearest justification for these alternatives: they differ from each other. Each alternative has its advantages and disadvantages, and the balancing between the different trade-offs – lead times versus total costs, for example – is what makes the further inspection meaningful. The alternatives will be discussed in more detail in chapter 5, whereas the next subchapters describe the methodology of this thesis.

4.2. Optimizing locations

The location optimization in this thesis is based on centers of gravity, but the results of the calculations are considered based on their viability. This means that the coordinates received from the calculations are not taken per se, but they are used as a starting point for considering appropriate locations near the center of gravity. This can be justified by the fact that the negative effect of moving the chosen location some tens – or even hundreds – of kilometers from the absolute mathematical center of gravity is easily outweighed by the benefits of finding a location nearby that has more suitable infrastructure or other benefits. This is evident also in choice of Tatarstan as the location for the manufacturing plant: although Tatarstan is the center of gravity on many different parameters, the fact that there is a special economic zone in Tatarstan with tax benefits and various other advantages aimed at attracting investments must have had more of an impact on the decision to locate the plant there.

As described already in chapter 3.2.4., the centers of gravity are calculated based on a point extrapolated to the surface of the Earth from the average (or center of gravity) of three-dimensional coordinates for the coordinates of Company X distributors or – for other sets of data – the capitals or largest cities of Russian federal subjects. These are then weighted by population, gross regional product or human development index. A step-by-step description of the process goes as follows:

1. List the points used (distributor locations, capitals)
2. Find their coordinates
3. Find their weights (such as sales, population, GRP)
4. Convert latitudes and longitudes to xyz-coordinates
5. Multiply the new coordinates by their weight
6. Calculate averages for these weighted coordinates
7. Extrapolate this average to the surface of the Earth

All steps are easily executed by using a spreadsheet program. Also, steps 4–7 require some understanding of geometrics and trigonometry, but the calculations used in them are still derived from basic mathematics and can be completed with functions found in spreadsheet programs.

The centers of gravity are created by a “grid” representing Russia in a simplified form. The grid is made up of points represented by distributor locations or major cities, and they are then weighted by the data. The idea is that calculating the exact location of each Russian inhabitant or Company X customer is impossible and a simplified, or aggregated, grid made up of less than hundred points will still yield results that are applicable to simulate the behavior of the entire market – especially when they are then used to calculate averages and centers of gravity.

As the calculations are done using a spreadsheet program, once worksheets have been created, they can be easily used for different sets of data and different configurations. As long as the worksheets have been configured thoroughly, changes in most every parameter can be tested. If data is available, the application of any set of demographic or other data – be it infant mortality or foreign direct investments – can be applied by merely copying and pasting the data to the weight column in the sheet. All this requires is finding the data and sorting it to fit the list of locations, which, of course, can be a laborious task in itself. The key is to adhere to data that is relevant for the cause. In this case, infant mortality would hardly be that.

Actual distances between two locations are calculated as great circle distances multiplied with a circuity factor. As the circuity factor is a constant, its application is relevant only when absolute values for distances or ton-kilometers are calculated. When the relative portions of different alternatives are calculated – as was the case in figure 4.8., for example – adding the circuity is not necessary, since it is the same for all great circle distances.

Earlier it was mentioned that the circuity factor for Russia is 1.37 on average (Ballou et al. 2002). This means that if the great circle distance between place A and place B is

100km, approximate road distance is 137km. In table 4.1., some comparisons are made between the road distances given by Google Maps compared with distances calculated with the formulae used in this thesis.

Table 4.1. Examples of circuity factors between Yanino, the Tatarstan plant and chosen distributors compared to the circuity factor for Russia proposed by Ballou et al. (2002)

	Yanino			Tatarstan plant			***Russia***
	Great circle (km)	Road (km)	Circuity	Great circle (km)	Road (km)	Circuity	
Moscow	699	759	1.09	871	1047	1.20	
Rostov-on-Don	1528	1798	1.18	1278	1656	1.30	
Ufa	1613	2063	1.28	272	322	1.18	
Tyumen	2030	2535	1.25	844	1129	1.34	
Surgut	2234	3318	1.48	1362	1926	1.41	
Novosibirsk	3089	3820	1.24	1931	2323	1.20	
Krasnoyarsk	3560	4610	1.29	2507	3113	1.24	
Irkutsk	4433	5662	1.28	3389	4166	1.23	
Average			**1.26**			**1.26**	***1.37***

The table indicates that the circuity factor would be even lower than that proposed by Ballou et al. (2002), since the average circuity factor for both Yanino and the Tatarstan plant is 1.26. As a matter of fact, only one of the destinations has a value higher than 1.37 and that is the remote Surgut in western Siberia.

The low circuity factors could be explained by a number of reasons: Firstly, these examples are distances between major cities between which the road network may be expected to be denser than in other parts of the country. This is evident in the distance between Yanino and the Moscow distributor, where the circuity factor between these two metropolises is the lowest, only 1.09. Another explaining factor is the method used by Google Maps. It chooses roads based on the minimum distance between two points. These roads may not necessarily be accessible for heavy traffic, or their speed limit, for example, may be unsuitable. Also, the sample used in table 4.1. is small. Thus the circuity factor given by Ballou et al. (2002) is used it this thesis, as it is based on more scientific evidence than the mere examples shown in table 4.1.

4.3. Modes of transportation

The viable possibilities for modes of transportation are ships, railroads and roads. The difference between these three modes is that ships are used to import products whereas railroads and roads are somewhat mutually complementing or mutually exclusive alternatives for transportation within Russia.

In all alternatives, the products imported to Russia will be carried by ships arriving at Saint Petersburg. This was defined by the original restrictions of this thesis, and any alternatives for this, meaning mostly land transportation to Russia through Europe, is left for future research.

Within Russia, the choice of transportation mode is limited to railroads and road transportation. As it was discussed before, airfare is impractical for the purpose, as are waterways – inland or overseas. If railroads are used, they are used for long transportations with large quantities of products being transported, which is a natural consequence of the advantages and disadvantages of railroad transportation. Thus railroads are most suitable for transport from manufacturing to Company X’s distribution centers, for example.

Limiting the choice of transportation mode to roads and railroads within Russia is also reasonable as the network of roads and, to lesser extent, railroads suit the use of centers of gravity; if a transportation mode with a sparser network were used, centers of gravity would be ill-fitting. As it was concluded in the previous subchapter, circuity factors for roads in Russia are relatively low, and thus centers of gravity provide applicable results for them. The chosen railroad lines are few, and their orientations also follow great circle distances with sufficient precision.

Other than the mode itself, further consideration is limited to the applicability of the mode – road or railroad – to each alternative. This means whether or not the distribution center is located near road or railroad networks, and what kind of access there is to them. This, of course, is somewhat iterative, as access to transportation networks is already considered when locations are selected within the alternative.

An example of a possible transportation mode selection for alternative 1 can be seen in figure 4.9. The figure is only an example, and the alternative used is chosen only because all three modes of transportation – sea, railroad and road – can be used and easily represented by pictograms.

Figure 4.9. An example of possible transportation modes for alternative 1: ships are used to import goods, railways bring them to the Tatarstan DC and deliveries to distributors are carried by road. (Map base from Wikimedia 2007)

Once again, the figure is only a simplification of possible transportation modes. Ships would be used for importing the goods and trucks to deliver them to customers from the distribution center, but the leg of transportation between Yanino and the Tatarstan distribution center can be carried by rail or by road. Also, railroad transportation could be considered for some of the delivery transportations for the most remote parts of Russia, as their accessibility or the viability of operating the route by road may be low.

The modes of transportation chosen are not definite nor are they eternally binding. The situation may change over time and one mode of transportation may become more viable than the other. This is mainly a concern when it comes to substituting road transportation with railroads or vice versa, but on a larger strategic scale, the role of importing goods by ships can also be questioned. Questioning it, however, will not be done within the scope of this thesis. The alternatives can accommodate changes in transportation mode, and adaptability is also considered a strength for the alternatives.

4.4. Logistics costs of the alternatives

The comparison of the logistics costs of the alternatives is based on proportional comparison of the transportation costs of the alternatives as oppose to absolute cost calculations. This is a result of the scope of the thesis restricting the extent of the analysis. Also, the delay in getting data to be used in this thesis – and the unavailability of data directly from Company X – meant that this part of the analysis is extremely superficial. In an ideal situation, the logistics costs of the alternatives would be a key indicator on the viability of each alternative. Also, costs and financial benefits are what investors need to see in order to be convinced that they will get return on their investments.

For this thesis, only the relative sizes of transportation costs are considered. Thus the two other main components of logistics costs – warehousing and inventory costs – are left for future research, since their assessment within the scope of this thesis and the availability of information would be based on mere assumptions.

4.5. Lead times of the alternatives

Researching lead times thoroughly would require an in-depth analysis of the entire supply chain of Company X. Distribution is only a part of it, and optimizing lead times by only altering distribution routes will not result in optimal solutions: the entire production strategy of Company X would have to be considered.

In this thesis, the assessment of lead times is limited to comparing how long the distances to distribution centers are. This is what is relevant to Company X from an operational point of view, but also the distances from distribution centers to distributors are compared. Currently, having a short distance to distributors is only a service element, but if a new distribution model with deliveries to distributors or bypassing the intermediaries is adopted, short distances will improve lead times directly.

4.6. Risks related to the alternatives

The assessment of risks is invariably qualitative in this thesis, whereas sensitivity analysis (addressed in the next subchapter) offers a more quantitative approach to risks.

Another description of this division is that the qualitative assessment *names* the risks related to each alternative after which their significance is considered verbally and, obviously, in a qualitative manner. Sensitivity analysis is then used as a quantitative means to assess their significance – both through likelihood and magnitude. The assessment is somewhat iterative, or at least the assessment of risks cannot be entirely one or the other, quantitative or qualitative; a quantitative assessment would require great amounts of data on a multitude of subjects, which is impossible within the scope of this thesis, and a qualitative analysis needs some validation from numbers.

Risks are listed and assessed in their own subchapter. Also, suggestions for actions to control these risks through avoiding, reducing or transferring the risks will be presented. Some measures, of course, are already considered when the alternatives are developed, as the best way to diminish risks is to prevent them already in the planning phase.

Pairing the risks with the positives related to each alternative, a SWOT analysis is also conducted. The analysis provides summative information on the strengths, weaknesses, opportunities and threats of each alternative. This is also coherent with the aim to produce results that are easily legible, since a SWOT matrix is an effective visualization of relevant factors. SWOT analysis could be considered a method to compare the alternatives per se, but here it is considered to be a part of risk management.

4.7. Sensitivity analysis

Sensitivity analysis, like logistics costs and lead times, would require a deeper examination of the situation of Company X – and access to more detailed data. In an ideal situation, the sensitivity analysis would also be based on the calculations used to assess logistics costs and lead times, but as these calculations are superficial to begin with, sensitivity analysis will only be made based on few parameters. They are “what if” thought experiments as oppose to exhaustive mappings of all possible variables that could affect Company X in Russia – or on a corporate level.

Thus sensitivity analysis is limited to changing the arrangements of distributors and seeing how these changes affect the centers of gravity and the positioning of the distribution centers. As the current sales of Company X are dominated by the three largest Moscow-based distributors, a reasonable thought experiment is to see how losing one (or even two) of these distributors will affect the outcome. Another example would be to examine how gaining a large distributor in a non-Moscow location would affect the outcome.

5. RESULTS

This chapter has two parts: Firstly, possible end-demand and actual sales are mapped as a means to find locations for distribution centers based on their centers of gravity. The incongruity between demographic data and sales data is also used to approximate actual end-customer locations and future strategic development. In the second part, the results of each alternative for the parameters chosen are presented.

5.1. Possible end-demand versus actual sales

5.1.1. Possible end-demand mapping

In this subchapter, different data are fitted to the map of Russia to generate centers of gravity in situations both where the Russian market is treated as a single entity and where Russia is split in two along the 60th meridian, roughly where the Ural Mountains are situated. The aim is to find concentrations that could correlate with possible demand and thus optimal locations for distribution centers.

Different sets of demographic data have been gathered, and those are population, gross regional product (GRP), human development index (HDI) and Company X's distributors both in Russia and in all of the CIS countries. The lists of distributors have been taken from Company X's external website and they have not been weighted.

For population, GRP and HDI, each of the 83 federal subjects of Russia is represented by the coordinates of its capital or largest city when no capital exists, and the entire weight (number of inhabitants or GRP) is then allocated to those coordinates. The method used to calculate the HDI centers of gravity is somewhat more peculiar: the population of each federal subject is multiplied by the *tenth power* of its HDI score in order to differentiate the scores. Had this not been done, the differences would be even lesser than they are now as the HDI scores vary only from 0.732 in Tuva to 0.962 in Moscow. Population, GRP and HDI are by no means specific to Company X and they are derived from general demographic data. The data is retrieved from Russian Federation Federal State Statistic Service for population and GRP (2004 & 2008 respectively) and United Nations Development Program (2011) for HDI.

The different distributions of population, GDP and HDI (or its tenth power multiplied with the population) of each federal subject is visualized in figure 5.1., where the location of the major city in each federal subjects represents each respective federal subject.

The figures are shown in relation to Moscow. Thus the area of the bubble symbolizing Moscow remains a constant but the others vary.

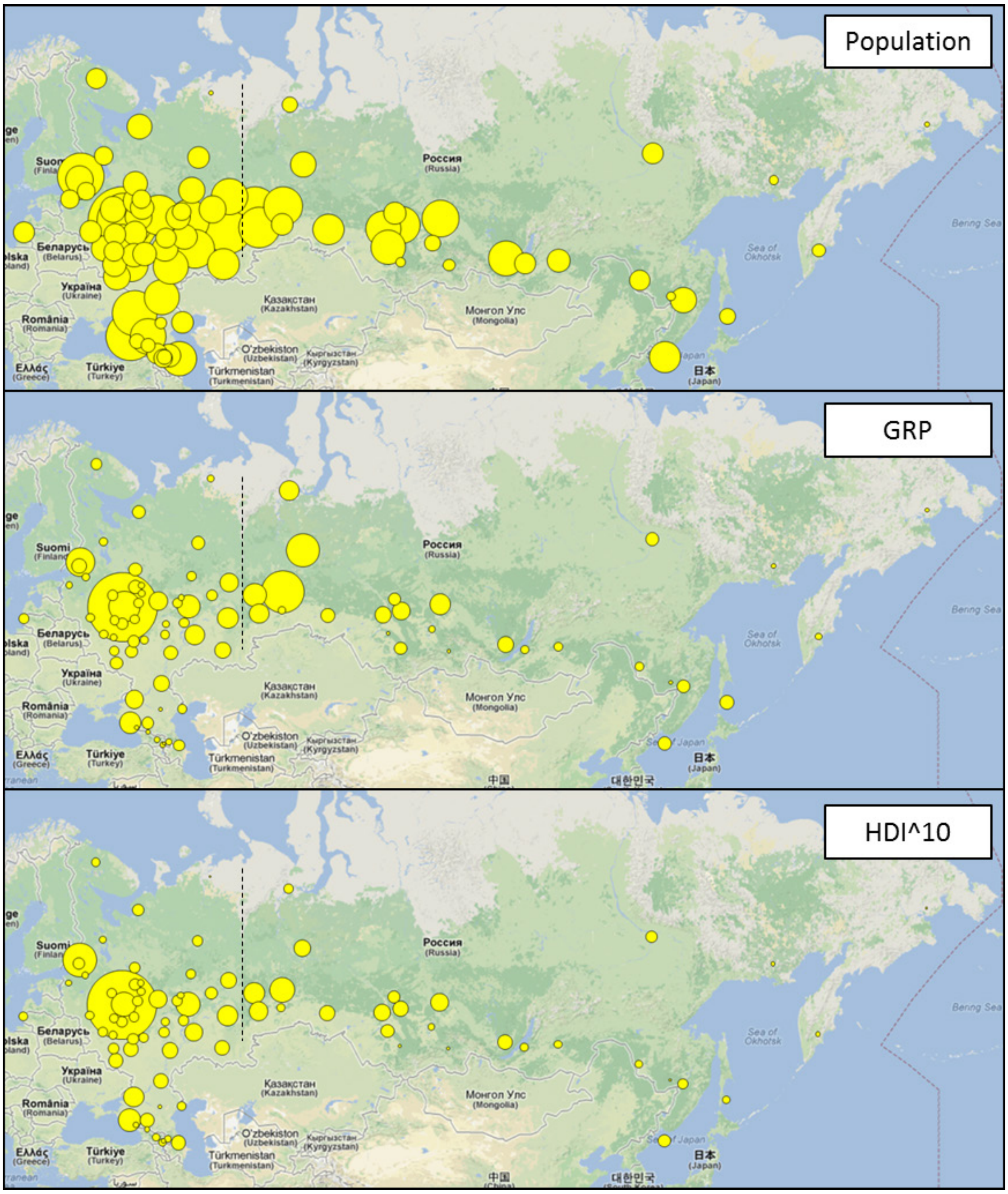


Figure 5.1. The distribution of population, GRP and HDI in Russian federal subjects compared to Moscow. (Map base from Google Maps 2013)

The figure shows that Moscow is the most significant federal subject on all parameters, but its population is not as disproportionately large as its share of GRP and HDI. Noteworthy is also that Tyumen Oblast, being the center for West-Siberian oil and natural gas industries, holds a significant portion of GRP. This is also true for Khanty-Mansi Autonomous Okrug situated north of Tyumen Oblast, and it has the third largest GRP after Tyumen Oblast. Only after them come Moscow Oblast and Saint Petersburg. HDI shows visually similar results as GRP, but Tyumen and Khanty-Mansi do not stand out there. This could be a result of the wealth generated by natural resources being distributed unevenly, for example.

The previous figure showed the distributions of different demographic parameters, but the ultimate aim of this subchapter is to provide centers of gravity for the same data. Although the distributions were different, with Moscow dominating GRP and HDI and Tyumen having a surprisingly large portion of GRP, for example, the centers of gravity are similar, as will be shown next.

If only one center of gravity is calculated for the entire Russia, its location is – regardless of the data used to calculate it – significantly close to the Tatarstan plant. The results are shown in table 5.1.

Table 5.1. Different centers of gravity for one location and their distances from the Tatarstan plant.

Center of gravity for...	**latitude (N)**	**longitude (E)**	**Distance from the plant (km)**
Tatarstan plant	*xx.xx°*	*xx.xx°*	*0*
Population	56.48°	53.52°	118
Gross regional product	57.98°	53.12°	248
HDI^10	56.82°	49.48°	192
Distributors (Russia)	56.10°	55.27°	204
Distributors (incl. CIS)	54.74°	53.38°	149

As table 5.1. indicates, even the farthest center of gravity – the one calculated based on GRP – is situated only 250 kilometers away from the Tatarstan plant. Thus the location of the plant itself is quite optimal for any business that serves the Russian market. The different points are visualized in figure 5.2. They are collectively referred to as the "Tatarstan cluster", and this name will be used later on in the thesis.

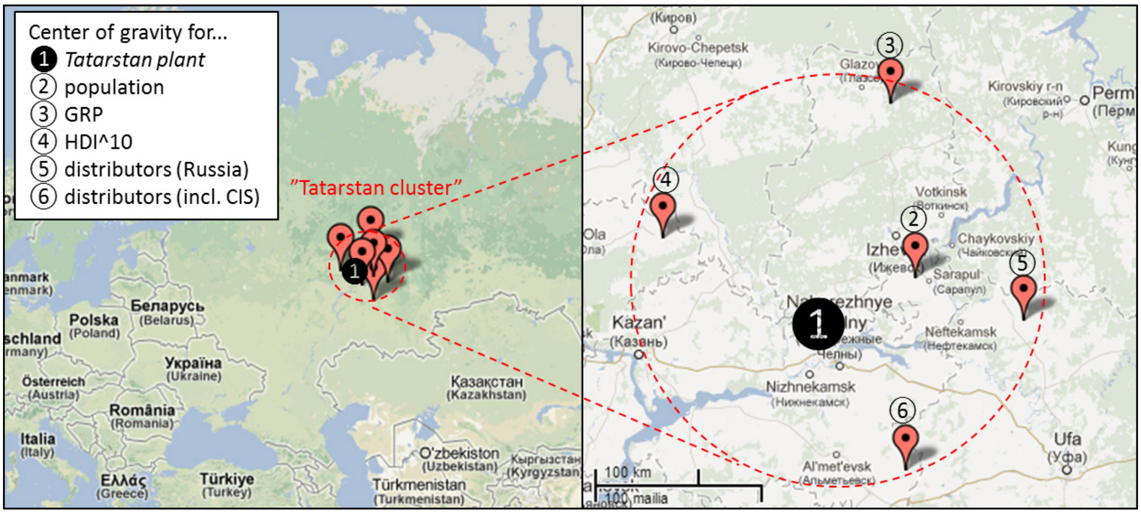


Figure 5.2. Locations of the Tatarstan plant and the single centers of gravity. The location of the plant is only indicated roughly. (Map bases from Google Maps 2013)

As figure 5.2. shows, the mapped points for the various centers of gravity form a cluster that is situated rather tightly around the plant – at least when the entire Russia is considered. This, of course, is only the reality when only one point is calculated for the Russian market, and another take on the issue is to cut Russia in two, which is discussed next.

When Russia is divided along the Ural Mountains, the center of gravity for its western, European side is situated southeast of Moscow, and the center of gravity for its eastern, Asian side is situated roughly north of Novosibirsk. This applies to all sets of data used, although variation is higher than was the case with locations for only one center of gravity. This is evident especially east of the Urals, where the geographic area covered is vast, and the different weightings can disperse the centers of gravity more.

The results for different centers of gravity for a divided Russia can be seen in table 5.2.

Table 5.2. Different centers of gravity for two locations and their distances from the Tatarstan plant

	WEST OF THE URALS (<60°E)			EAST OF THE URALS (>60°E)		
Center of gravity for...	**lat (N)**	**lon (E)**	**Distance (km)**	**lat (N)**	**lon (E)**	**Distance (km)**
Tatarstan plant	*xx.xx°*	*xx.xx°*	*0*	*xx.xx°*	*xx.xx°*	*0*
Population	53.82°	42.00°	680	57.26°	88.94°	2240
Gross regional product	55.23°	40.64°	719	59.11°	81.75°	1798
HDI^10	54.78°	40.52°	737	57.95°	84.62°	1974
Distributors (Russia)	54.01°	43.60°	575	56.70°	79.15°	1666
Distributors (incl. CIS)	52.63°	42.16°	733	55.41°	78.57°	1657

The distances from the Tatarstan plant calculated in table 5.2. serve a different purpose than they did in table 5.1. In the first table, the distances were an indicator of how compact the Tatarstan cluster was, whereas here the distances indicate an approximate distance from the two clusters to the plant in Tatarstan.

The results from the table are visualized in figure 5.3. The figure indicates, again, that these points form two distinct clusters. As was the case with the Tatarstan cluster, the clusters are given names according to their geographical proximities. The western cluster is referred to as the "Moscow cluster" and the eastern one is called the "Novosibirsk cluster".

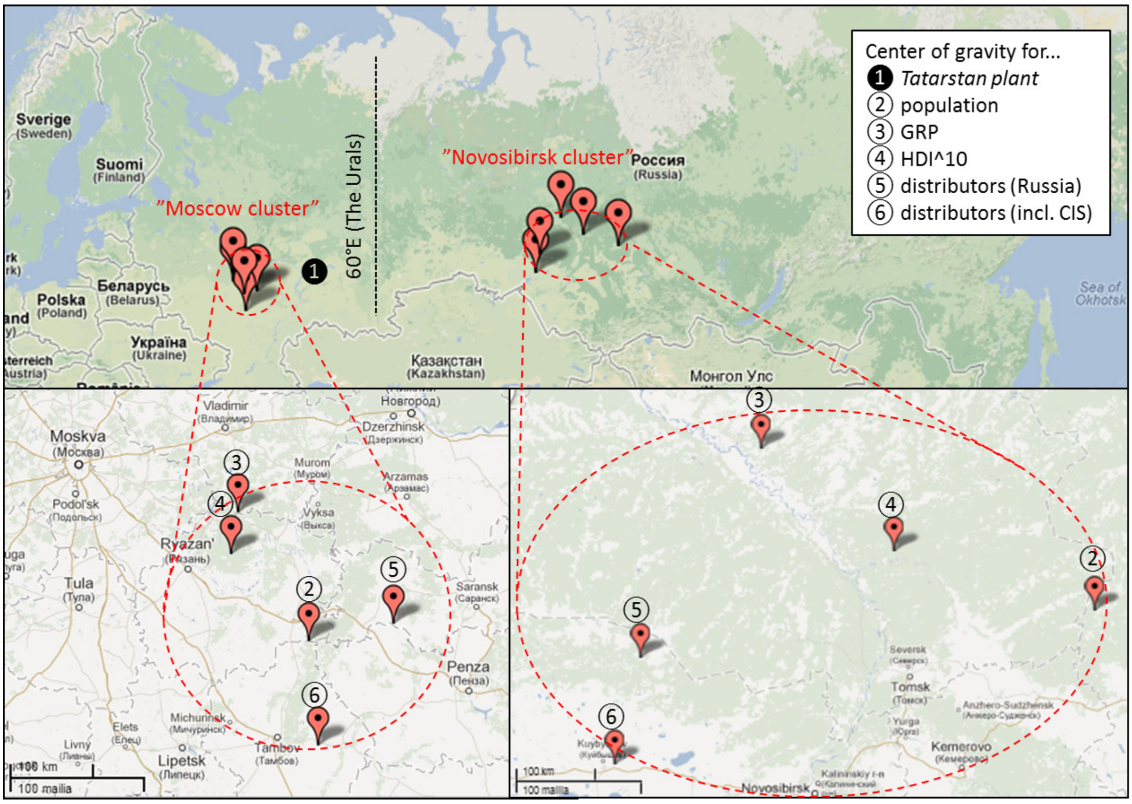


Figure 5.3. Locations of the Tatarstan plant and the centers of gravity when Russia is split east and west of the Ural Mountains. (Map bases from Google Maps 2013)

As can be seen from figure 5.3., for the western side, the points are situated close to each other southeast of Moscow. The GRP and HDI centers of gravity are the ones closest to Moscow whereas the distributor points – both for Russia and the entire CIS – are the farthest, and the population center of gravity lies between these four.

This is where the unweighted distributors affect the outcome. The positioning of the distributors seems to be even *ahead of its time* west of the Urals, as the western distributor centers of gravity seems to deviate from Moscow more than the points based on demographic data. In reality, as will be shown later, the volumes passing through Moscow distributors are significantly higher compared to those in the more remote corners of the country, and the weighted distributor centers of gravity are closer to Moscow.

If the unweighted distributor centers of gravity seemed to be ahead of their time in the west, the conclusions could be the complete opposite east of the Urals: the distributors seem to concentrate more to the west than population, GRP and HDI. This is closer to the results that actual sales numbers will yield, but as it was already mentioned, intricate conclusions should not be made when the distributors are not weighted in the calculations. The difference between the distributor and demographic centers of gravity is over 500 kilometers, and it can be explained in part by the development of the country with the eastern parts of the country following the west. GRP and HDI centers of gravity are also less to the east than the center of population, but they are also more to the north, which may be due to the abundance of natural resources in the north.

What is noteworthy with both the western and eastern clusters calculated here is that they ignore inbound transportation, and they only describe demand. If inbound transportation were taken to account, meaning if the transportation to the distribution center was prioritized, the centers would gravitate more toward the Tatarstan plant (and, to lesser extent, toward Yanino) since the amount of products coming from those two sources equals that going out. As this subchapter is interested in demand only, considering inbound transport is left for later discussion.

The key implications of the centers of gravity derived from external sources are:

1. Regardless of the type of data used, the centers of gravity seem to form remarkably tight clusters.
2. When only one center of gravity is calculated, it seems to be located in the vicinity of the Tatarstan plant, in the Tatarstan cluster.
3. Two centers of gravity yield two clusters: the Moscow cluster situated southeast of Moscow and the Novosibirsk cluster situated north of Novosibirsk.

Thus two different possibilities emerge: If the importance of Russia east of the Urals is highlighted, the two-cluster setting would imply two discrete centers for demand – the Moscow and Novosibirsk clusters – which are also possible locations for distribution centers. Noteworthy is that the location of the western Moscow cluster is different from the singular Tatarstan cluster and lumping these two together would result in a less than optimal situation considering how possible demand is distributed.

Naturally, change in the parameters examined here happens over time. An example of this is shown in figure 5.4., where the development of the single center of gravity for gross regional product in Russia can be seen from 1998 to 2007.

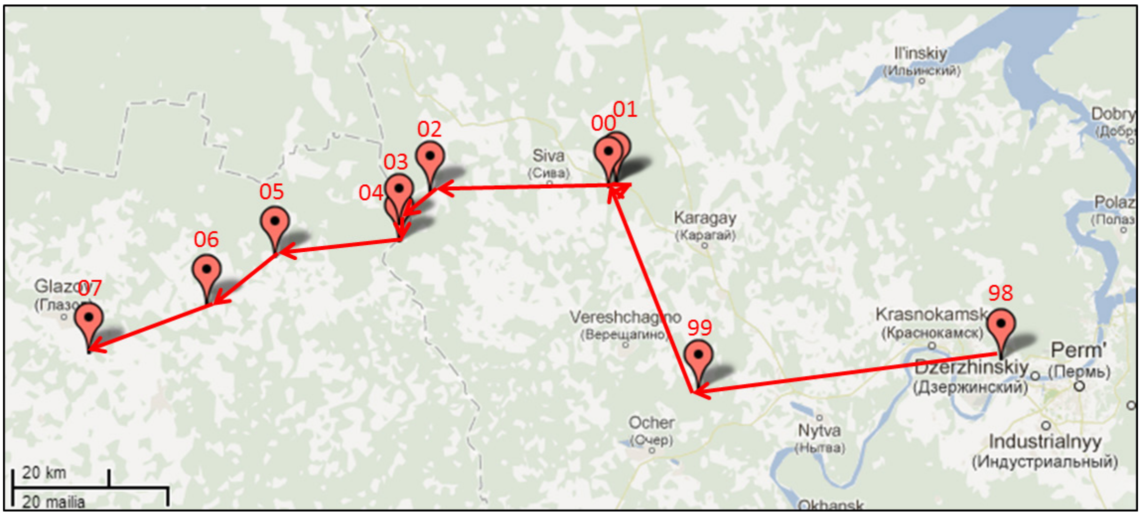


Figure 5.4. An example of a center of gravity moving over time. The center of gravity for Russian GRP has moved west toward Moscow some hundred kilometers between 1998 and 2007. The seemingly non-linear "jump" between 1999 and 2000 is due to changes in regional allocations of GRP. (Map base from Google Maps 2013)

The movement westward, closer to Moscow, is evident in figure 5.4. The points for years 1998 and 1999 seem to differ from the rest, but that is largely due to regional divisions in the data: prior to year 2000, the GRP of the resource-rich Yamalo-Nenets Autonomous Okrug and the Khanty-Mansi Autonomous Okrug were allocated to Tyumen Oblast, which is situated much farther to the south than these two autonomous okrugs. Thus Tyumen Oblast was disproportionately weighted and it "pulls" the entire center of gravity southward for 1998 and 1999.

Other than showing how "determined" the movement of a center of gravity can be, the significance of the figure above is to showcase that movement *does* happen. Thus the results of a center of gravity are not optimal forever. Change, of course, is always present in a business environment, and the figure above is a welcome reminder of how it happens in reality.

The aforementioned population, GRP and HDI data are general demographic data, but distributors and their locations, on the other hand, are relevant to Company X only. In this subchapter, they were not weighted, and their volumes or other parameters were not taken to account. The list of distributors was adapted from Company X's external website under the different regional sites for Russia and other CIS countries. This was done to show what approximations can be done without data derived from actual sales numbers, meaning these calculations could have been done by anyone with an internet connection. Mapping based on actual sales numbers, which are not available publically, is done next, and they differ from the results seen in this subchapter.

5.1.2. Actual sales mapping

In the previous subchapter, the data used was from external sources, and it was used to speculate potential end-customer centers of gravity. In this subchapter, however, the situation is changed as actual sales information derived from Containerships is used.

The results are different from the ones in the previous subchapter, as is to be expected. These are the results of *distributors*, and as such, they are greatly Moscow-oriented. Distributor sales are paired with volumes going to that distributor, but that does not correlate completely with actual material flows. In fact, many Moscow-based distributors collect the goods from Yanino and drive the load to the end-customer without ever visiting the Moscow warehouse – if there even is one. Data of these end-customers is impossible to collect, and it is in the distributors' best interest not to give it, as their role as it could potentially threaten their role. Thus the data derived from external sources in the previous subchapter could be worth more in assessing end-customers' locations for future strategies, as it is not distorted by Moscow distributors.

Figure 5.5. shows the disproportionate shares of the three largest distributors on the left. In the figure, they are named Moscow 1, Moscow 2 and Moscow 3. On the right, the chart visualizes the small volumes passing the Urals. The charts are based on sales between October 2012 and May 2013, and many smaller distributors had no transactions during this time. In fact, Company X's accumulated master data on their customers includes almost 150 customers (distributors or others), but less than 50 had transactions during the focal time period.

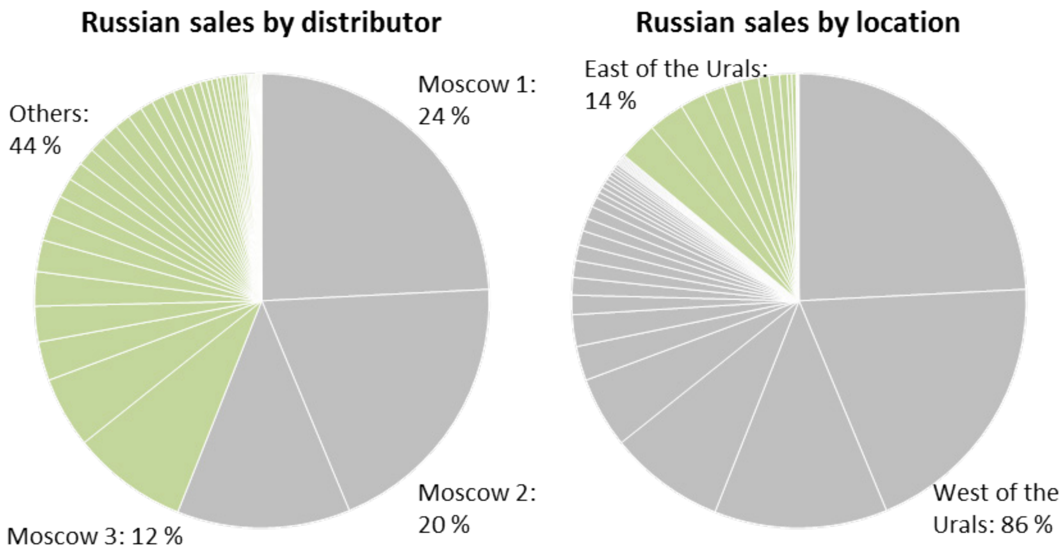


Figure 5.5. Russian sales by distributor and by location based on sold cartons. The first chart shows the dominance of the three largest distributors and the second chart illustrates how small the sales are east of the Urals.

As the figure indicates, the three largest distributors based in Moscow constitute 56 % of all sales. Even though the Moscow metropolitan area holds a substantial portion of the population of Russia, 10%, Company X's sales are wildly disproportionate compared to this. However, as it has been stated numerous times before, the actual end-customers of those distributors are not in Moscow, and the calculations based on demographic data are attempts to approximate their locations around Russia.

Not only do the three largest distributors constitute over half of the sales, but the Pareto principle – according to which 80% of consequences are caused by 20% of reasons – applies to Company X's sales in Russia remarkably well; nine of the forty-five distributors (exactly 20%) constitute 79,3% of the sales, which is visible in figure 5.6. The nine largest distributors are spread out more evenly: only four of them are situated near Moscow whereas the rest are in Saint Petersburg, Rostov-on-Don, Yekaterinburg, Chelyabinsk and Izhevsk.

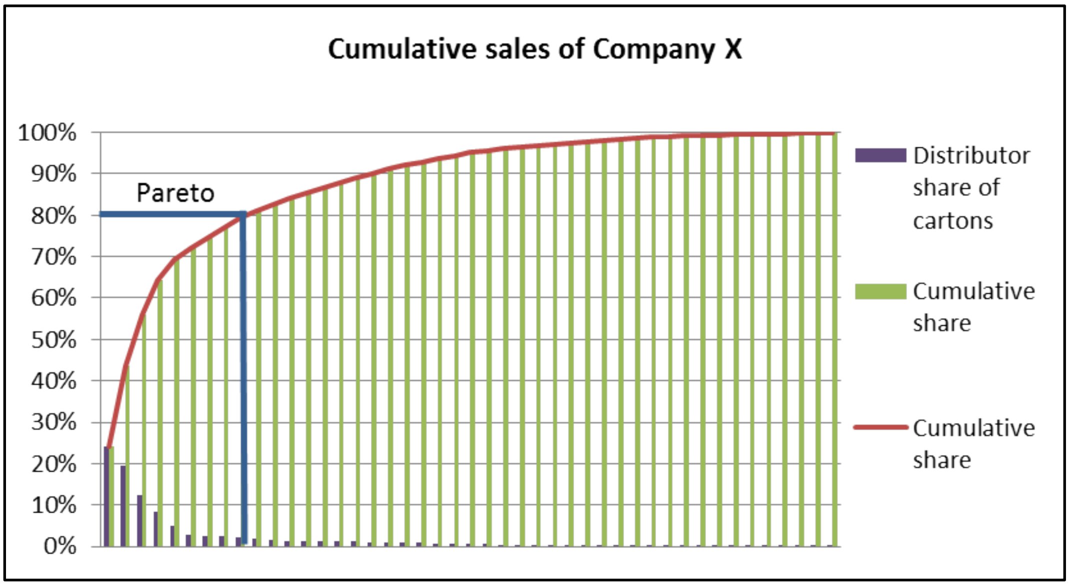


Figure 5.6. Cumulative sales to Company X's distributors. The Pareto principle can be seen as nine distributors (20% of 45 distributors) constitute 79,3% of sales.

Another key result of the sales figures is that sales east of the Urals are also not in relation to population there. Only 14 % of the sales are directed over the Urals although approximately a quarter of the population lives there. Also, much of the sales are concentrated to Yekaterinburg, Chelyabinsk and Tyumen, which lie only "barely" beyond the Urals. Were the division line drawn more to the east, the results would change greatly.

As it was stated earlier, seasonality does not affect Company X's sales much. This can be seen in figure 5.7, where Company X's sales are plotted based on their availability date, meaning the date the distributor can come collect the load from Yanino. Bars show the daily volumes, but their variation is so high that a 14-day moving average has been added. The highest daily values (reaching 23000 cartons) have been cropped out of the graph as the trend is more important than single large daily amounts – which are only added to show that there is great daily variation.

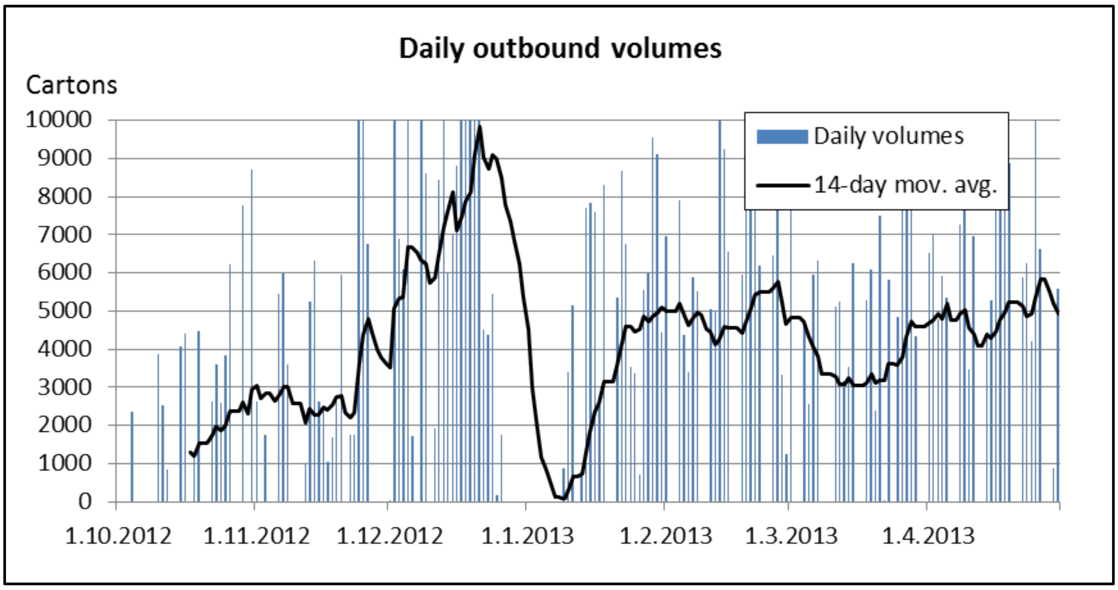


Figure 5.7. Daily outbound volumes (October 2012-April 2013) with a moving average.

Three different stages can be seen in the figure: Firstly, there is fast growth before the turn of the year. This is caused by both the ramp-up of Yanino and preparation for the turn of the year; as the year (or quarter) comes to a close, Russian companies buy more to balance their VATs for the fiscal period. This is an annual cycle which the figure above clearly demonstrates. The turn of the year also marks the beginning of long holidays, which can be seen as the second stage: from December 27th to January 8th, there was no movement in Yanino. The last stage is the leveling of the demand during the first months of 2013. Thus considering demand to be quite level is justifiable, since the fluctuation in sales during the focal period was mostly due to the peak at the end of the year and the standstill during long holidays.

If the temporal fluctuation of sales was of expectable, the geographic distribution holds more surprises. In figure 5.9., the sales figures that were shown in the pie charts earlier are plotted on a map.

Figure 5.8. Company X's sales to distributors between October 2012 and May 2013. Each circle is a separate distributor, and the size of the circle symbolizes the volume of sales. (Map base from Google Maps 2013)

The figure shows that the vast majority of distributors are situated west of the Urals (60ºE), and the three largest distributors are Moscow-based. Also, most of the sales beyond the Urals happen near the mountain range in Yekaterinburg, Chelyabinsk and Tyumen. Noteworthy is that the actualized sales are based on a time-period of roughly half a year, and most of the distributors had no sales during this time. The distributor farthest to the east based on these sales numbers is at Krasnoyarsk (92ºE) although the accumulated list has customers as far east as Vladivostok (132ºE) and Sakhalin (142ºE).

Figures 5.9 and 5.10. show the same results presented already in the previous subchapter, but the centers of gravity based on actual sales are added to them, indicated by yellow triangles. The weight used is the number of cartons delivered, but the results are markedly similar for other actual sales indicators: the center of gravity based on tonnages carried lies only six kilometers from the carton-based one shown in figure 5.9.

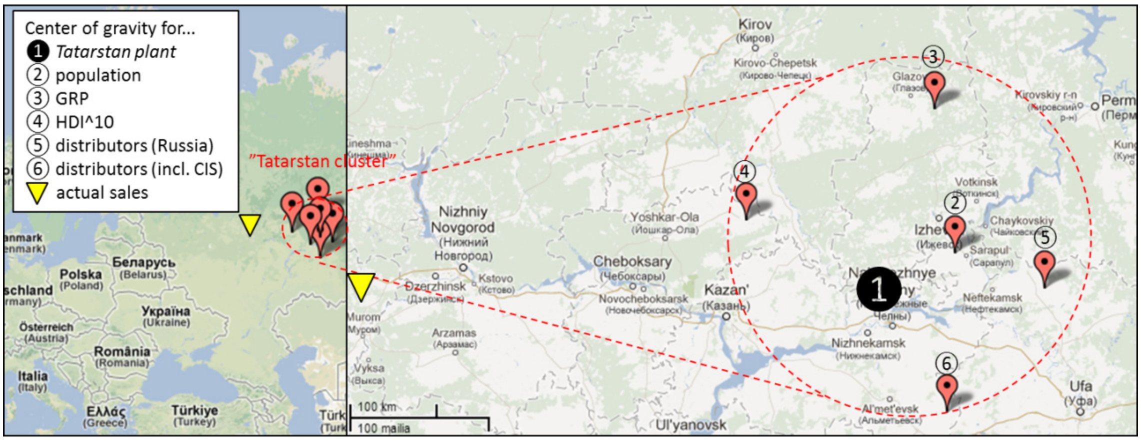


Figure 5.9. Results of one center of gravity with actual sales added. (Map base from Google Maps 2013)

This single center of gravity based on actual sales (56.00°N 42.02°E) is situated near Nizhniy Novgorod. As the figure above indicates, this point is some hundreds of kilometers away from the Tatarstan cluster. This is due to the size of the Moscow distributors, whose weight pulls the center of gravity west. This is also evident in figure 5.10., where the effect of the Moscow distributors is limited to the western center of gravity, but the distributors in Yekaterinburg and Tyumen pull the eastern center of gravity west away from Novosibirsk – so much that the symbol for it does not fit in the smaller map.

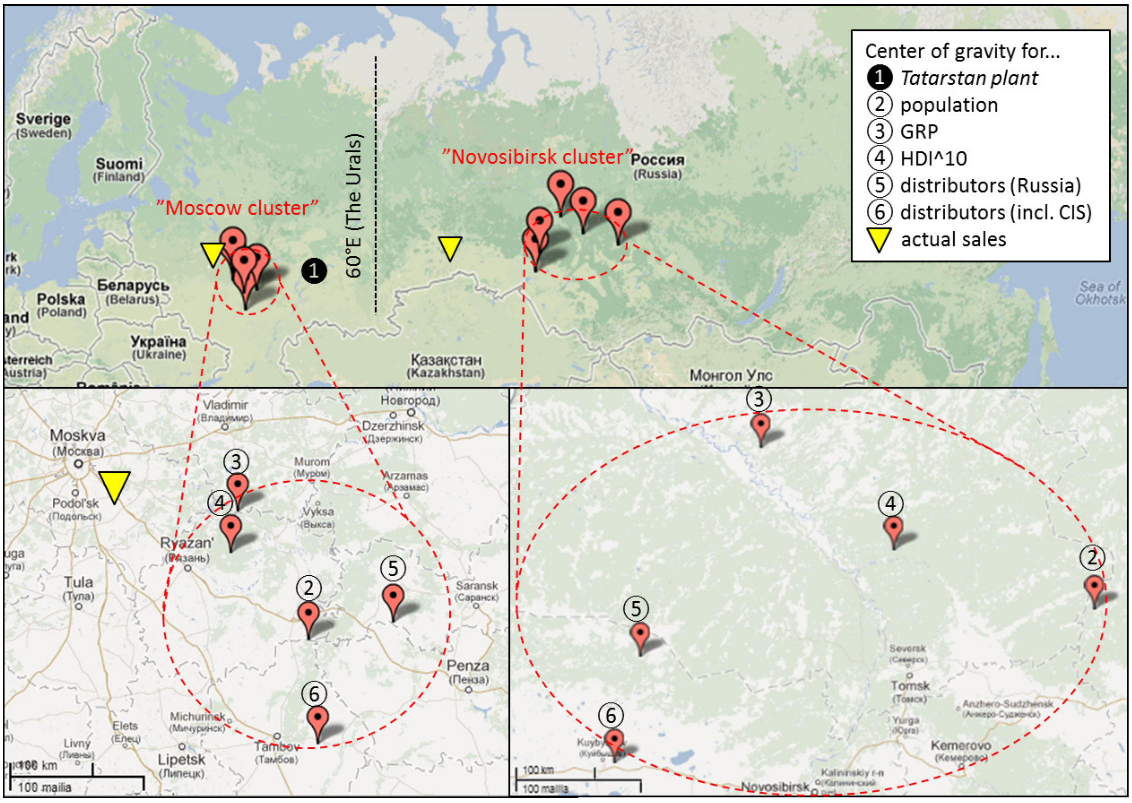


Figure 5.10. Results for two centers of gravity with actual sales added. (Map base from Google Maps 2013)

As can be seen, the western center of gravity (55.42°N 38.16°E) is even closer to Moscow than the "Moscow cluster" calculated before. For the eastern center of gravity, the point is roughly a hundred kilometers east of Tyumen. The location of the eastern center of gravity (56.68°N 67.57°E), however, is subject to large fluctuation as the distributors there are situated over an immense geographical area and their orders vary over time.

The key implication of the centers of gravity for actual sales compared with the different data used before is that current sales do not follow the distribution of population, GDP or Company X distributors in Russia – especially east of the Urals. Only the western center of gravity near Moscow is similar for demographic data and actual sales. Whether this is a result of the Moscow-based distributors distorting the results or the market penetration being low in the less developed parts of the country is speculative. What is certain, however, is that moving a distribution center east of the Urals would facilitate this development and follow the distribution of wealth and population there. Locating it at the "Novosibirsk cluster" may be too far-fetched, but nearer alternatives, such as Yekaterinburg, do exist. The locations will be discussed next among other parameters.

5.2. Results for the different parameters chosen

The results for the different alternatives are given parameter by parameter next. The alternatives are the base case (Yanino and Tatarstan DCs), alternative 1 (one DC) and alternative 2 (two DCs). The variation of alternative 2 where a total of three distribution centers would be operated in an attempt to combine the benefits of the base case and alternative 2 is dropped, because its benefits are minimal compared to its costs in light of actual sales numbers, as was shown before.

The results are given in a manner where it is assumed that most distributors will still come to collect the products from the distribution center, but the possibility for a future where Company X delivers the products or even eliminates the middlemen is kept open. The extent to which each alternative serves that possible future scenario depends on the alternative.

5.2.1. Locations

For the base case, the locations are clear: a commodity distribution center is situated near the Tatarstan plant and a non-commodity distribution center remains at the current location in Saint Petersburg. Determining the exact location and configuration of the Tatarstan distribution center is not reasonable within the scope of this thesis, and it will be left for later research. What is necessary, as is the case with other locations, is connection to a train line, and it is possible in the general area where the plant is situated.

For alternative 1, two possibilities exist: the single distribution center can be situated near the Tatarstan plant, or it can be situated near Moscow. This is a question of prioritization: the Tatarstan location is convenient for Company X, but Moscow would serve the three largest Moscow-based distributors (who constitute more than half of Company X's sales) perfectly. The difference between situating the distribution center in Tatarstan or Moscow is shown in figure 5.11., where actual sales numbers are compared.

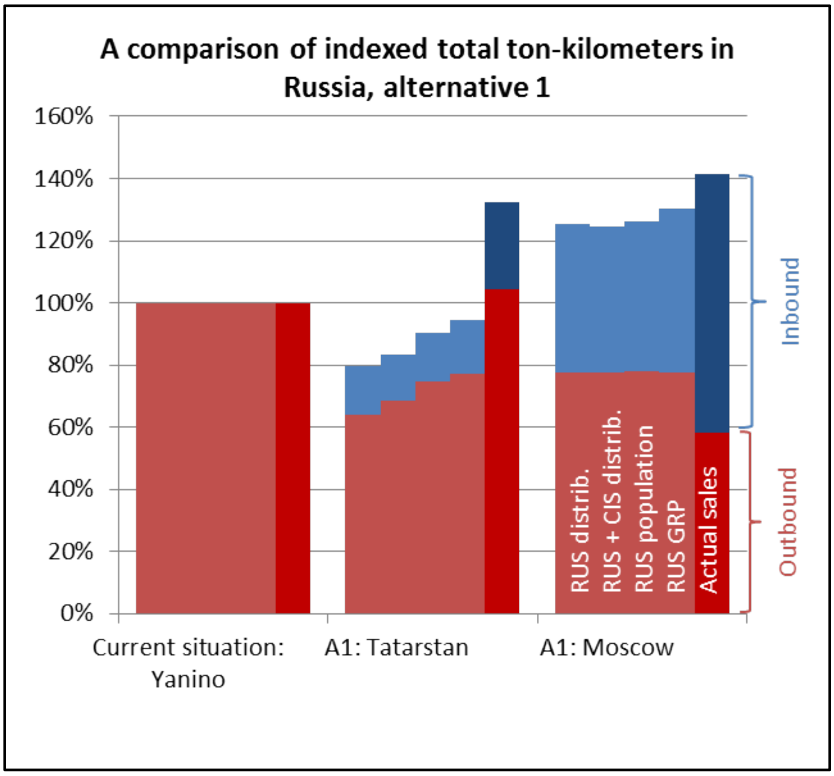


Figure 5.11. A comparison of indexed total ton-kilometers in Russia for alternative 1 variations having the single distribution center in Tatarstan or Moscow

As the figure shows, in light of demographic data (four first narrow columns), Tatarstan is a far better option as it lies at the center of gravity for the entire nation, and near the manufacturing plant. Considering actual sales numbers (last narrow column in darker hues), the situation is different: in total transportation Moscow and Tatarstan are quite level. However, for Tatarstan, outbound transportation is much higher than for Moscow.

Placing the distribution center in Moscow would be a service for the distributors, and their ease would come at the cost of Company X transporting more products and operating a distribution center away from the plant. Thus Tatarstan is chosen as the location for alternative 1, and Moscow is considered for the next alternative, as it is more "service-oriented" by definition.

For alternative 2, the two distribution centers are situated west and east of the Urals. For the western side, the location is clear: the distribution center is situated near Moscow. This location is most sensible based on both demographic and actual sales data. The eastern distribution center, however, is different. Demographic data would suggest the Novosibirsk cluster as a prime location for a distribution center. This, however, would currently result in most of the products being carried all the way to Novosibirsk only to be brought back west to Yekaterinburg, Chelyabinsk and Tyumen, which lie closer to the Urals. Thus the location for the eastern distribution center is chosen to be Chelyabinsk: it is near the actual sales center of gravity, but it also suits the road and railroad network, as it is a major industrial center and has connections to other major cities. Chelyabinsk, however, is by no means a superior location like Moscow, and arguments for placing a distribution center at some other location “east of the Urals yet not too far” can be made. The main point of the entire alternative is to situate the distribution centers at locations that are convenient for distributors, and Chelyabinsk is such a location.

For each alternative, the locations chosen do not leave out the possibility of rail transport, nor do they limit the use of roads in any ways. Railroads, however, are mainly limited to transportation between manufacturing and distribution centers, as those connections are the ones with most traffic. Bearing this in mind, Saint Petersburg and the Tatarstan plant are accessible from both Moscow and Chelyabinsk by railroad. Transportation mode is considered in more detail next.

5.2.2. Transportation

For the base case, all transportation is performed by road. From the Tatarstan distribution center, semitrailers are a logical solution as the products are produced there. As for the Yanino distribution center, keeping the products in the containers in which they enter Russia is one alternative, if the delivery transportation is carried out by Company X. This would result in a great decrease in damages to the products during transportation and make the process simplified.

For alternative 1, the outbound transportation from the only distribution center in Tatarstan is carried out by trucks. As the products arriving from Saint Petersburg have to be unloaded from the containers to be stored and/or combined with the Tatarstan-produced items, semitrailers are the logical choice. The transportation between Saint Petersburg and Tatarstan, however, is well suited for train transportation, as the material flow happens between two nodes and it constitutes a fifth of all products sold in the Russian market. As Company X does not currently carry its products on rail, this leg of the transportation can still be performed on road, as it is a tried and tested alternative. A disadvantage here is that the products cannot be loaded on train directly at the Moby Dick terminal in Saint Petersburg, since no railway connection exists there, and this means that more handling of the products is required.

For alternative 2, the situation is similar to alternative 1: the delivery transportation from distribution centers are carried out by road, but the connections between distribution centers and Tatarstan or Yanino can be performed by train. However, the flows entering the eastern distribution center in Chelyabinsk, especially the flows coming from Yanino, are so small that this may not be viable, and train transportation suits the Moscow distribution center better.

5.2.3. Logistics costs

As for logistics costs, the main component that can be quantified within the scope of this thesis is the distance traveled by each carton. Thus transportation costs are considered, but warehousing and inventory costs are left for future research, as examining them would be based on mere assumptions.

As the transportation mode is mostly by road, the cost can be considered to be a constant, and thus the transportation cost would, at its simplest, be calculated by the volume of cartons multiplied with the average length of a journey and the aforementioned cost of transportation. As the volume of cartons is also a constant when comparing the alternatives, the only component that differentiates the alternatives is the average length of transportation, which can be seen in figure 5.12.

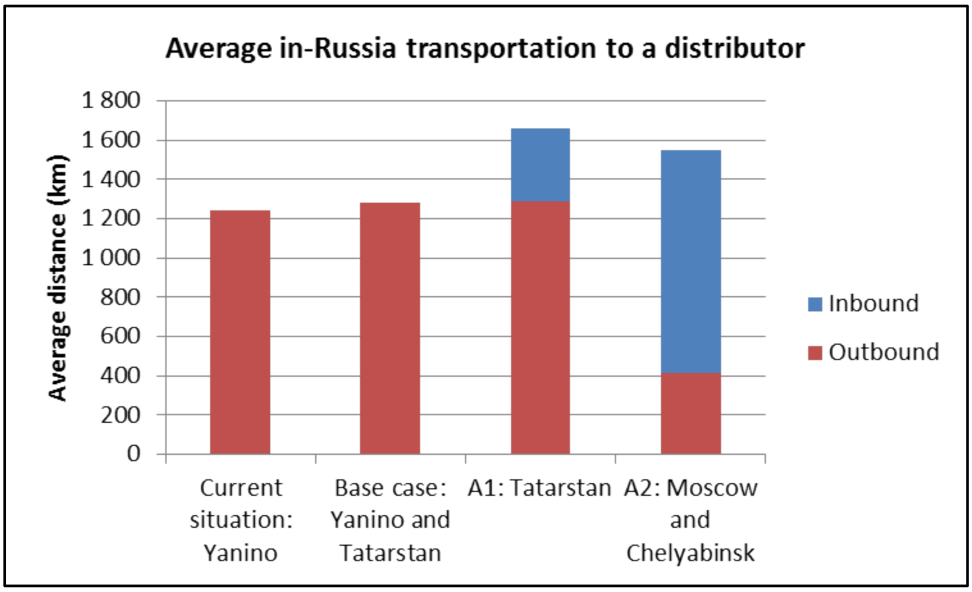


Figure 5.12. Average in-Russia transportation to a distributor in kilometers. The figure shows how long a journey an average carton travels in Russia to reach a distributor.

In the figure above, the length of the journey is based on great circle distances multiplied with the circuity factor 1.37 discussed earlier in the thesis. The figure is based on averaging, and although it can be used to assess logistic costs, it does not present the actual distribution of distances. For example, in alternative 1, no carton has an inbound transportation of the roughly 370 kilometers shown in the figure; 80 % of cartons travel zero kilometers within Tatarstan, and 20 % travel the roughly 1800 kilometers between Yanino and Tatarstan. Thus the average shown in the figure is what its name implies – an average.

Also, the “ownership” of transportation is a key issue once again. The outbound transportation shown in the figure in red is currently carried out by distributors, and thus it causes no added costs to Company X. Thus only alternative 1 and alternative 2 have in-

Russia transportation costs that are currently relevant to Company X. This, of course, will change if Company X starts to deliver its products to its distributors or end-customers.

5.2.4. Lead times

In general, lead times are greatly affected by the entire supply chain. As such, improving lead times by addressing distribution is only part of the process, and the results are not an exhaustive description of lead times. Also, the scope of this thesis does not allow in-depth analysis of lead times spanning the entire supply chain, nor does the author have information on the actual Company X's processes outside of Russia to support such investigations.

If lead times are assessed from the point of view of a product becoming available to the distributor at a distribution center, the main differences between the different alternatives are a result of the different distances between the distribution centers and operations therein. Thus the main component here is the transportation time taken from Saint Petersburg or Tatarstan to the distribution center. The distances for different alternatives are listed in table 5.3.

Table 5.3. The distances loads travel in Russia to reach a distribution center. Note that these numbers are "absolute", not averages. Although some cells have the value ”0km”, the real distance is some (tens of) kilometers.

	Current	Base case		A1	A2	
	Yanino	**Yanino**	**Tatarstan**	**Tatarstan**	**Moscow**	**Chelyabinsk**
Import	0km	0km	n/a	1740km	780km	2420km
Tatarstan	n/a	n/a	0km	0km	1020km	750km

As the table indicates, the inbound transportations vary between the alternatives. If a truck is roughly expected to travel 800 kilometers over one day, the inbound transportation in alternative 1 would add over two days to the lead times of imported products. Alternative 2 has a roughly a day to add to products being available at the Moscow distribution center and three days for imported and one day for Tatarstan goods at the Chelyabinsk distribution center.

However, the actual added lead times depend on the handling speed and the overall margins in the ordering process. Company X currently has a lead time of some 14 days for its products coming from Europe, and the three added days at Chelyabinsk may be tolerable for the eastern distributors, since they will be able to collect their products much closer to their own locations than Saint Petersburg.

Instead of examining the situation from the product becoming available to the distribution at the Company X distribution center, lead times can be assessed from the distance to distributor. In the current situation, where products are sold on an ex works basis, this addition to the transportation could be left out of lead time examination. However, it is an important service element, and in a future where products would be delivered to customers by Company X, this part of transportation would link directly to lead times. As a matter of fact, if high levels of inventory would be kept at the distribution center, the distance would be the most significant component affecting lead times.

Distances to current distributors mapped on the sales figures shown before can be seen in figure 5.13. In the figure, the size of each bubble indicates the volume of sales and the color shows the maximum distance to distributors. The base case includes distributors collecting products from both warehouses, Yanino and Tatarstan. The results for the base case are poor, since the maximum distance is defined by the distance to the farther distribution center. The opposite applies to alternative two, which benefits from distributors collecting all of their products from one of the two distribution centers, Moscow or Chelyabinsk, depending on which distribution center is nearer. Also note that the distances mentioned are great circle distances, and the actual road distances can be approximated by multiplying the great circle distances with the circuity factor 1.37 proposed by Ballou et al. (2002).

The choice of coloration for the figure is also based roughly on how many days it would take to drive the products from the distribution center to the distributor. Green (0-500km great circle distance) would happen within a day, yellow (500-1000km) two days, orange (1000-2000km) three to four days and red (over 2000km) over four days.

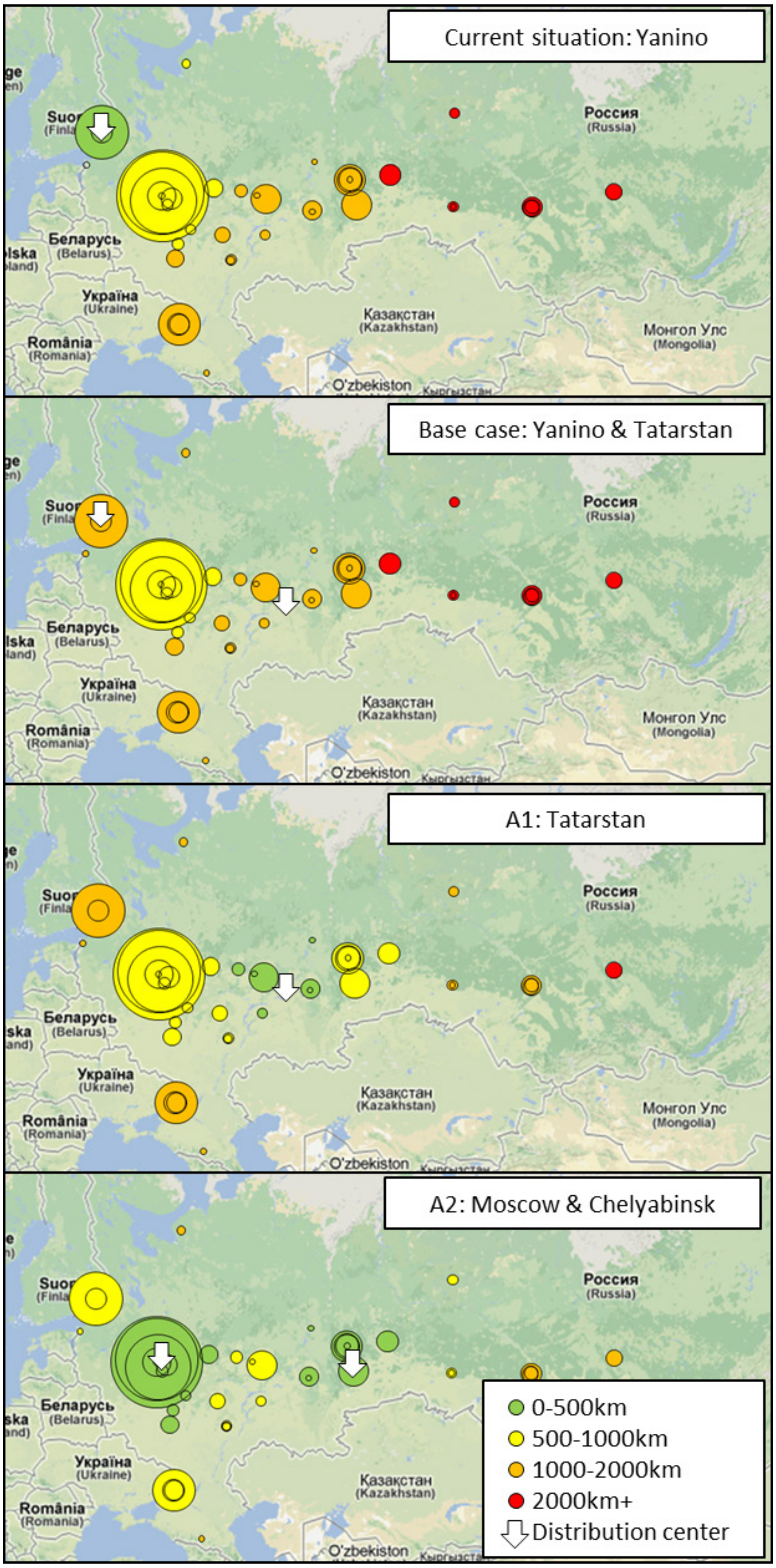


Figure 5.13. The maximum great circle distance for a distributor in each alternative. Note that in the base case, the results are poorer as all deliveries are assumed to have products from both distribution centers. (Map base from Google Maps 2013)

The figure clearly supports the notion that has become evident a multitude of times earlier: alternative 2 with distribution centers in Moscow and Chelyabinsk provides the best lead times from the distributors' point of view. However, getting the products to the distribution centers takes a longer time as the distribution centers are at locations other than Yanino or Tatarstan.

The base case has poor lead times as the distance to the farther distribution center defines the lead time, but the figure could have been drawn in another way, too, since in the base case the distributors still get some of the products from the nearer distribution center. Still, the base case suffers from distance to the large Moscow distributors, as do all others alternatives that do not include a distribution center in Moscow.

5.2.5. Risks

Next, the risks of each alternative are assessed based on SWOT analyses. The strengths, weaknesses, opportunities and threats for the base case are listed in table 5.4.

Table 5.4. SWOT analysis for the base case with a commodity DC in Tatarstan and a non-commodity DC in Yanino

Strengths	**Weaknesses**
Existing locations Tatarstan location favorable in light of demographic data No inbound transportation in Russia Alternative is "production driven" anyway, so changes in sales do not affect it as much Little reloading Damaged goods returned quickly to production to be reused	Two DCs inconvenient for distributors Two DCs expensive for Company X No Moscow DC Empty trucks to Tatarstan – little demand there
Opportunities	**Threats**
No new, remote DCs: can be added later on	Losing existing business because of inconvenience Losing potential business because of inconvenience

The main weaknesses and risks related to the base case have to do with the inconvenience caused by distributors having to operate in two distribution centers. In part, this can be diminished by adding distribution centers to the solution later on. This means that, in a way, the base case can be seen as one step in the gradual progression of Company X, and it offers a frame for other distribution centers to be added.

Again, the effect of being near distributors or end-customers is speculative. Its importance is stressed in this thesis, but in reality, the priorities of Company X's clients could be completely different. The current situation gives some indication of this; even though the distributors have to collect their products all the way from Saint Petersburg, they still do it. Since the company has not tried a different approach, the amount of business that could be lost or won by changing this positioning is speculative.

A key implication not discussed earlier in the thesis is the cost of transportation to and from Tatarstan. As there are little volumes entering Tatarstan and much products leave Company X's plant and the surrounding special economic zone, the transportation flows are extremely unidirectional, which leads to higher costs. This affects both the base case and alternative 1 more, but alternative 2 is less affected. One means to balance this would be to transport raw materials, for example, in the trucks coming to Tatarstan. Ways to lessen the costs of this unilateral route are something that Company X will have to consider, since transportation to and from Tatarstan will happen in any case.

A similar SWOT analysis for alternative 1 is shown in table 5.5.

Table 5.5. SWOT analysis for alternative 1 with a DC in Tatarstan

Strengths	**Weaknesses**
Simple operations for Company X Customers get all products from one location Damaged goods returned quickly to production to be reused	No Moscow DC Inbound transportation Yanino-Tatarstan Back-and-forth transportation (such as Yanino-Tatarstan-Moscow for imports) Much handling of imports Empty trucks to Tatarstan – little demand there
Opportunities	**Threats**
"Close" to growth centers near the Urals such as Yekaterinburg	Losing business because of location Bottlenecks

Again, the largest risks are related to an inconvenient location of the distribution center. However, this is a lesser disadvantage for alternative 1 than for the base case, as the customers still get all of their products from one distribution center, which is situated at a location that is convenient when entire Russia is considered. Being equally close to everyone is, of course, insignificant in the eyes of a single distributor. Another disadvantage of having just one distribution center leaves the distribution model vulnerable to any disruptions and bottlenecks that can be alleviated by having more DCs – such as stocking out.

Also, the back-and-forth transportation between European production, the Tatarstan distribution center and the Moscow distributors is something that is a clear disadvantage: all imported products would be transported from Saint Petersburg to Tatarstan (past Moscow) just to be brought back to Moscow. This is a disadvantage that is simple to point out, but its true effect would require closer inspection of the volumes and routes travelled. After all, the benefits of concentrating distribution operations in one location may outweigh the obvious illogicality of the back-and-forth transportation. Also, if a strategy where products are delivered to distributors by Company X is adopted, there is nothing stopping the trucks from going to the distributors' distribution centers in Moscow or other locations "on the way" – provided that the coordination of operations between Company X and its distributors allows that.

Lastly, the SWOT analysis for alternative 2 is shown in table 5.6.

Table 5.6. SWOT analysis for alternative 2 with DCs in Moscow and Chelyabinsk

Strengths	**Weaknesses**
Closest to customers A Moscow DC Customers get all products from one location	Most inbound transportation Costs of two DCs Locations are new Much handling of all products
Opportunities	**Threats**
Chelyabinsk DC wins business east of the Urals Low lead times combined with local manufacturing boost sales	Moscow expensive and dangerous Chelyabinsk DC unviable

As for alternative 2, the main risks are associated with its main benefits. Being close to distributors means added logistics costs to Company X, and if proximity turns out to be a service element unvalued by the distributors, the entire alternative may become unviable. This is a real concern with the Chelyabinsk distribution center, since the entire motivation behind locating a distribution center there is based on the assumption that growth will happen there.

Another issue with alternative 2 is that Moscow is a risky environment to operate in. Competition is intense and business practices such as hostile takeovers are not unheard of there. Also, costs are much higher in Moscow than they are in other parts of Russia. This risk is diminished here by simply stating that the Moscow distribution center should be situated in the vicinity of Moscow, not within the city center. As most of the points for centers of gravity were situated east or south-east of Moscow, the distribution center could be situated on that side of the metropolis. The exact location, however, is left for future research, as the benefits of being close to distributors are easily outweighed: being some tens of kilometers closer is not a spectacular service to distributors, but it can have an immense impact on the investment and operating costs of a distribution center.

5.2.6. Sensitivity analysis

The sensitivity analysis here is limited to testing two scenarios and their effect on the centers of gravity for sales calculated before. The first scenario is losing the three largest Moscow-based distributors, meaning that sales to them would, for some reason, drop to zero. The second scenario is gaining a large distributor in Novosibirsk – the volumes have been chosen to match the largest distributor Company X has currently.

The purpose of these scenarios is to show how fluctuation in the business environment affects the viability of locations for distribution centers. The first scenario is far-fetched, but as Company X is heavily dependent on the three largest distributors, the effect could be devastating. Gaining a large distributor in Novosibirsk – at least as large as in the second scenario – is also unlikely, but it symbolizes the implications that growth in the eastern parts of Russia in general could have for Company X.

Figure 5.14. shows how the scenarios move the centers of gravity when only one point is calculated for all of Russia.

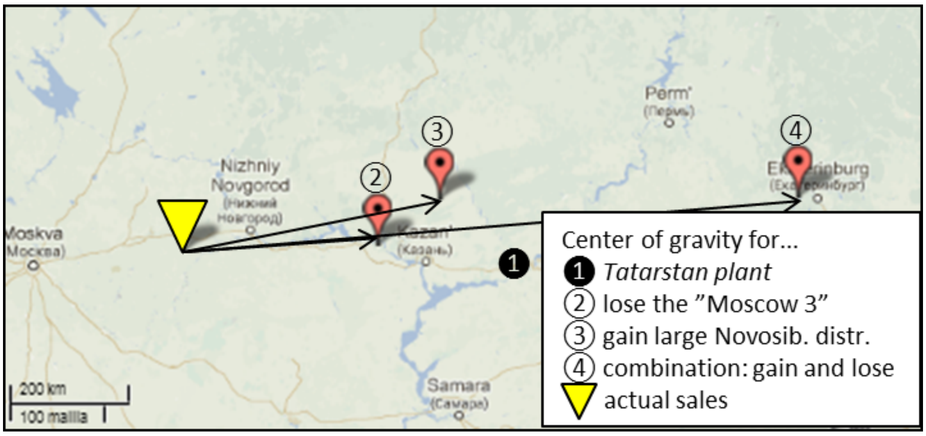


Figure 5.14. The single centers of gravity for sales in hypothetical situations where the three largest Moscow-based distributors are lost or a large Novosibirsk distributor is gained - or both.

As the figure shows, both scenarios move the center closer to the Tatarstan plant, roughly north of Kazan. However, their combined effect is even larger, and the center of gravity for such a situation would be near Yekaterinburg, This, of course, is highly unlikely, but this indicates that significant movements can happen in the centers of gravity with a small number of changes – provided that they are significant enough.

The same scenarios are tested for western and eastern centers of gravity in figure 5.15. Note that the first scenario only affects the western center of gravity and the second scenario only affects the eastern center of gravity. There is no reason to examine their combined effect, as the combined effect is the same as the effect of the scenarios individually.

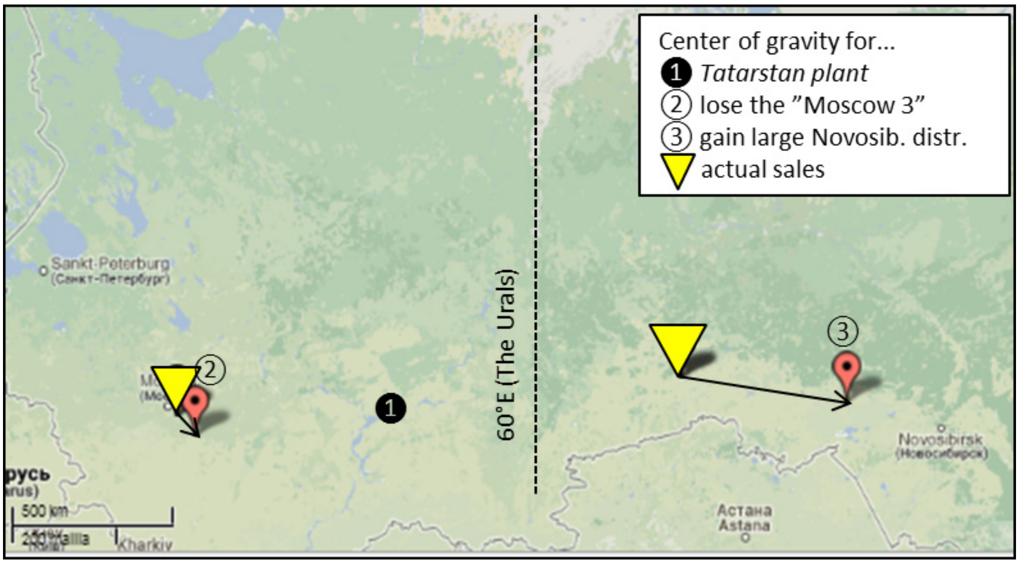


Figure 5.15. Western and eastern centers of gravity for actual sales and hypothetical scenarios. Note that losing the "Moscow 3" affects only the western point. The same applies to the eastern point and gaining a large Novosibirsk distributor.

The movement of the western center of gravity in the figure above is very little when the “Moscow 3” is lost, whereas the eastern center of gravity moves dramatically as a result of gaining a large Novosibirsk distributor. This is believable, since Moscow itself is located in quite a central location considering the sales in Saint Petersburg, Rostov-on-Don and other western Russian markets. Thus the center of sales is situated near Moscow even if Moscow itself is insignificant. In the east, the sales volumes are so small that the effect of one large Novosibirsk distributor can pull the center of gravity far eastwards.

The most significant implication of the scenarios is to show that Moscow is a reasonable location for a distribution center regardless of there being the three largest distributors. In a wider sense, it is of course logical that the sales of a company in a given country radiate away from the capital evenly.

Although the sensitivity analysis here is superficial, the different alternatives themselves are, in a way, products of sensitivity analysis and risk management. Developing different alternatives to suit different outlooks of the future is a means to prepare for the future.

Closer inspection of the alternatives and Company X’s Russian market situation in general in light of sensitivity analysis and other parameters is left for future research. The results achieved thus far are summarized in chapter 7, but they are discussed as for critique, future implications and applicability to non-Company X situations next in chapter 6.

6. DISCUSSION ON RESULTS

The results that were presented in the previous chapter and the methodology behind them are discussed in three parts in this chapter: In the first subchapter, they are critiqued based on their fallacies. Then, the implications of the results for Company X are presented briefly, but the actual plan for action is saved for conclusion in chapter 7. Lastly, implications for non-Company X uses are described and the methods and results from this thesis are applied to an imaginary situation for another company in two different markets. The purpose of this example is to show that consistency can be found between completely different sources of data: population data can be used to some extent to approximate the distribution of McDonald's restaurants, and the results for McDonald's restaurants in Finland and Sweden give remarkably similar implications as the calculations based on Company X in the Russian market.

6.1. Critique

The results of the thesis can be critiqued for a number of reasons. Although many are listed here, one should not forget that these negatives do not undermine the results presented previously; they merely show that all calculations and research have their fallacies. The results of this thesis were an attempt to describe different ways to examine the problem at hand – not an attempt to prove that one alternative is inarguably better than another. It is a welcome reminder that one absolute positivistic truth can be found only rarely, if ever.

Ultimately, the most significant weakness of the thesis and its results is that they were based on a limited set of data which was then analyzed superficially on many parameters. Also, the actual sales data used in the thesis was from only six months, but it was treated as if it was representative of Company X's sales in general.

Another aspect to be critiqued is that the different regions were treated evenly in the thesis. Calculating centers of gravity does consider the data used to weight the centers but it ignores the fact that concentrations of population, for example, are also oftentimes concentrations of expenses. This was avoided by stating that the Moscow distribution center, for example, should be placed near Moscow instead of situating it within the city, but this consideration could have been included in the models used to calculate centers of gravity, but that could have proven to be too labor-intensive considering the scope of this thesis.

Also, the centers of gravity were calculated based on demand, not actual transportation need. This means that the inbound distance to the distribution center was not included in the calculations, although it would have been a simple addition. It was left out as the approach was to determine the centers of gravity for demand. Had the inbound transportation been weighted somehow, the centers would have been closer to Tatarstan, since the volumes going from Tatarstan to distribution centers are 80% of all outbound (and inbound) transportation.

The basic division along the Urals can be questioned as well. As it was shown in the sales numbers, much of the sales beyond the Urals happen close to the mountain range, and moving the division line some degrees to the east would leave little sales there. Thus the importance of placing a distribution center east of the Urals would diminish. It could be argued that the decision to place a distribution center on the eastern side of the Urals in Chelyabinsk in alternative 2 is something of a matter of faith and willingness to believe that development will happen beyond the Urals – just because one wants it to happen.

It is questionable if the eastern distribution center in alternative two is considered a benefit by eastern clients, as it is a compromise. Since the actual sales numbers in the east proved to be so small, the location of the eastern distribution center had to be moved westward from Novosibirsk to Chelyabinsk. Thus the Chelyabinsk distribution center is more a service to the surrounding cities (such as Tyumen and Yekaterinburg) than a satellite distribution center in the east. However, in its defense, it should be said that choosing Chelyabinsk effectively eliminates driving back and forth in the east, which is something that would have resulted in long added ton-kilometers had Novosibirsk been chosen. Thus it is a portal to the east, not a satellite there.

The division could have been done north-to-south as well. None of the current alternatives included a distribution center in southern Russia, even though growth centers such as Rostov-on-Don are situated there, and CIS countries Armenia, Georgia and Azerbaijan are in that direction.

The transformation from the current distribution model to the alternatives was considered to happen suddenly and seamlessly. In reality, the process will happen step by step, and the ramp-up stage will surely be different from level production. This was considered superficially in alternative 2, where the Chelyabinsk distribution center was left as a possibility to be added later. Also, no reference to the schedule in which each alternative would be executed was made. However, there are no significant differences between the alternatives in this regard, since each of them consists of one or two mutually similar distribution centers.

In general, the main shortcoming of this thesis and any other research is that its results are only as good as the alternatives behind them are. This means that the basic configuration of the alternatives dictates the possible outcomes. Since alternatives such as having "all-inclusive" distribution centers in Yanino and Tatarstan were not considered, nothing can be said on their viability. As the number of alternatives limited within the scope of this thesis, all possible configurations could not be considered.

6.2. Implications for Company X in Russia

The alternatives give different possibilities for Company X based on its priorities – cost minimization, simplicity, serving customers, bypassing distributors and other factors. Thus the alternatives could be seen even as different strategies: the base case is clearly transactional, as it is constructed to be convenient for Company X – not for distributors. However, whether or not a distributor even minds the long transportation or having to deal in two different distribution centers is purely speculative. Alternative 1 with the single distribution center in Tatarstan is simple for everyone, but it results in many non-optimal routings. For example, all imported products going to Moscow will have to be driven from Saint Petersburg to Tatarstan only to be driven back to Moscow if no "finer" way of handling the distributors is organized. Alternative 2 with Moscow and Chelyabinsk DCs, on the other hand, is the most strategically far-sighted option as it follows the distribution of possible end customers – but it also suits the current Moscow distributors perfectly.

A plan of action will be given in the conclusions chapter of this thesis, but it should be reminded that that proposed alternative is only a proposal. As the final prioritization and detailed calculations are left for future research to determine, the plan of action is only one of the alternatives – and the others should not be forgotten.

6.3. Implications for other uses: Simulation of results in a non-Company X case

The results of this thesis can, of course, be applied to other environments as well. As a means to test the distribution structures proposed in this thesis, the author simulated a similar situation for McDonald's both in Sweden and in Finland. McDonald's was chosen as it has an extensive network of restaurants in both countries – and their coordinates are publically available online in GPS files.

The figures used to approximate demand were the GPS coordinates of McDonald's restaurants and the populations of Finnish and Swedish municipalities. Different centers of gravity were calculated for Finland and Sweden using the methods applied in this thesis. These were then mapped to a fictional situation that was made to be similar to Company X's, and it is described in table 6.1. Also, distribution model alternatives that are identical to the ones used in this thesis were created based on the centers of gravity. For this use, the unweighted “distributors”, meaning restaurants, are a far better fit for demographic data than are the actual sales numbers of Company X, as their number is larger and volumes similar; it is safe to assume that three largest restaurants do not constitute over 50% of the sales in each country as is the case with Company X’s distributors in Russia.

Table 6.1. The principles of fitting McDonald's in Finland and Russia to simulate Company X in Russia. The cities in italics are imaginary production and import locations.

Country	**Russia**	**Finland**	**Sweden**
Company	Company X	McDonald’s	McDonald’s
Major port city **- 100 % of volume flow now** **- 20 % of vol. in the future**	Saint Petersburg	*Turku*	*Malmö*
New inland manufacturing **- near center of population** **- 80 % of vol. in the future**	Tatarstan	*Tampere*	*Uppsala*
West/south center of demand	Moscow cl.	Hämeenlinna	Boxholm
East/north center of demand	Novosibirsk cl.	Siikajoki	Härnosand

This thought experiment includes Finland and Sweden being divided both by a mountain range like the Urals. In Finland the imaginary mountain range runs west-to-east along the 63rd parallel and in Sweden it is the 60th. This combined with the improvised production and importing structure makes the situation remarkably similar to Company X’s – especially since the population in Sweden and Finland is divided much in a similar way as it is in Russia. The main difference between these countries is that the population of Russia is mainly in the west leaving the east largely uninhabited, whereas Sweden and Finland hold most of their population in the south, and the north is sparsely inhabited. In a way, Russia is like Sweden and Finland rotated 90 degrees to the right.

The results of this thought experiment can be seen in figure 6.1., where the darkest hues represent Company X and Russia, followed by McDonald’s in Finland and Sweden, respectively. Actual sales data from Company X is left out and the locations of the distributions centers are based on demographic data (meaning Novosibirsk instead of Chelyabinsk for Russia in alternative 2) to show what can be derived from external sources.

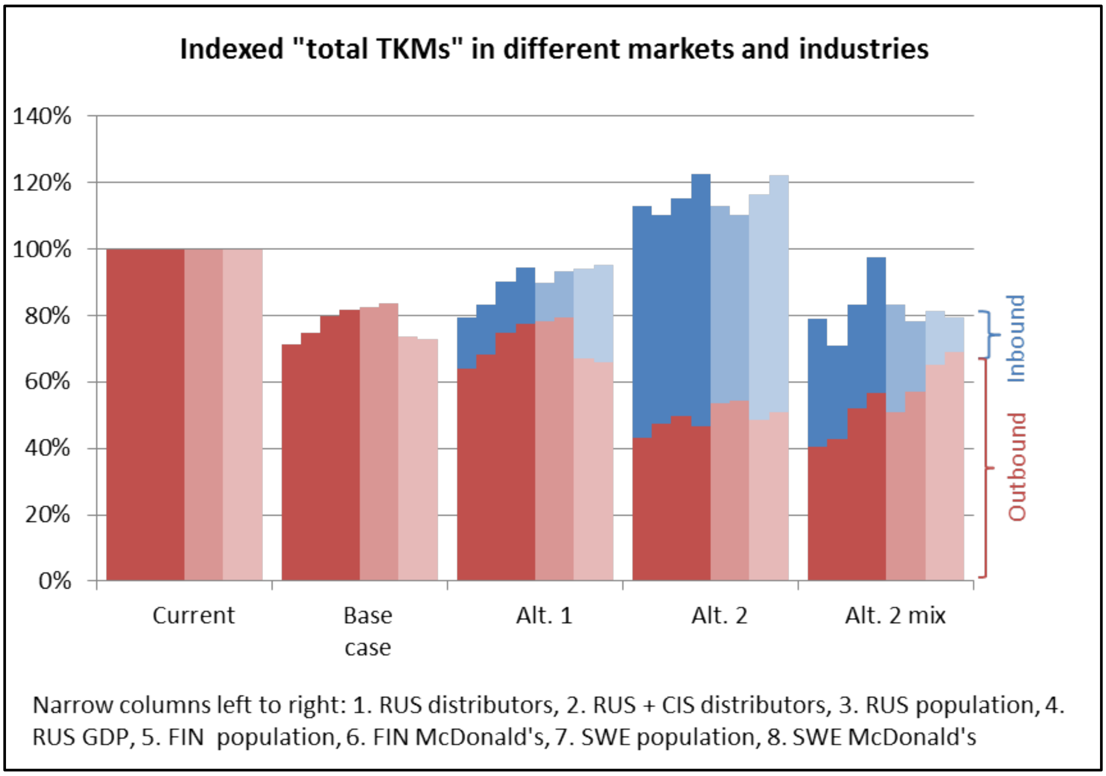


Figure 6.1. Indexed comparisons of "total TKMs" for Company X in Russia and McDonald's in Finland and Sweden

As the figure indicates, the data from the McDonald's examples in Finland and Sweden shown in paler colors is barely distinguishable from Company X's situation in Russia. Sweden does, however, seem to differ more in the proportions of inbound and outbound transportation.

Other than similarities between three completely different markets and two different industries, the similarities between population and McDonald's data in Finland and in Sweden are also remarkably level. This means that weighted population numbers seem to correlate well with the distribution of McDonald's restaurants (or vice versa), and when detailed "end-node" data is lacking, data such as the distribution of population in a given market may be effective in approximating it – provided that the market is developed and somewhat saturated, which is a safe assumption for McDonald's in the prosperous and stable Nordic countries.

What does this thought experiment suggest? The main conclusion of such a brief and superficial application of centers of gravity to "homogenized" yet completely independent situations seems to suggest that the method would direct the alternatives to similar relative levels of transportation regardless of the geographic location. As mentioned above, it also suggests that demand can be approximated based on data that is not direct sales figures of a company to be used in planning distribution networks.

The extent to which the results are applicable is questionable. In the McDonald's example, an imaginary supply chain was created for existing restaurant locations, and this yielded results similar to Company X's situation. This could indicate that similar conditions in different markets yield similar results. The question is: Would a different kind of supply chain construction (with numerous in-country production facilities, for example) yield mutually consistent results in markets that are independent of each other yet similar like the ones examined here? This is something that cannot be answered within the scope of this thesis, and other research in the field of using centers of gravity as location optimization tools may give the answer for this – or call for new research.

7. CONCLUSIONS

This chapter starts by summarizing the results of the thesis and presenting the proposed alternative in more detail. After that, future developments in Russia and in Company X's business environment that might affect the viability of the alternatives are discussed briefly. Lastly, suggestions for further research are made.

7.1. Results

7.1.1. Demand mapping

Actual and potential demand of Company X's products were investigated to find their centers of gravity, which would make for optimal distribution center locations.

The demand mapping done in the thesis showed that the geographic distribution of actual sales and demographic data differ from each other greatly. As Company X has only information on the locations of distributors and cannot access the locations of end-customers, demographic data can be used to approximate the distribution of end-customers.

In Russia, population is divided so that 75% of the population is situated west of the Urals and 25% east of the mountain range – which is roughly the opposite of how area is distributed. Also, wealth and development are distributed unevenly, and they are concentrated in Moscow. Other metropolises and growth centers exist, but Moscow's share is disproportionately large compared to its population – which is also sizeable. One other region with a discontinuity between wealth and population are the resource-rich regions in western Siberia, such as Tyumen Oblast, where the gross regional product is high but human development is low.

When centers of gravity based on demographic data are calculated, the single center of gravity is situated near the Tatarstan plant. If Russia is divided in two along the Urals, the western center of gravity is situated near Moscow and the eastern center of gravity is situated roughly north of Novosibirsk.

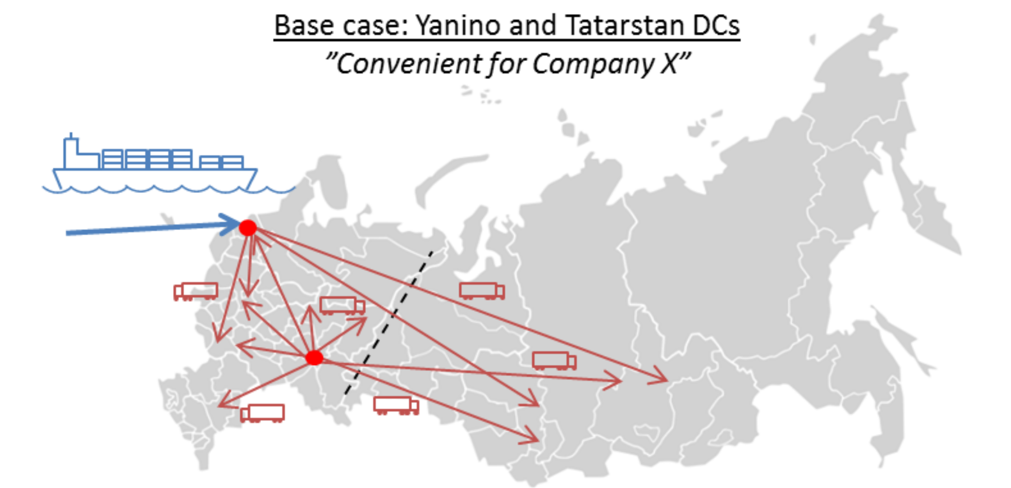
Even though demographic parameters are distributed unevenly over Russia, the distribution of Company X's sales is even more extreme. Over half of the sales are to the three largest Moscow-based distributors, and very little is sold beyond Novosibirsk. Thus the centers of gravity for sales are different from the ones based on demographic data: The single center of gravity is near Nizhniy Novgorod, and the western and eastern centers of gravity are in Moscow and near Tyumen, respectively. Thus the single center of gravity is pulled more toward Moscow and the eastern center of gravity is hundreds of kilometers to the west as oppose to demographic data.

The results of these sales mappings were used to determine the locations of distribution centers in the alternatives developed. Especially in alternative 2, the distribution centers in Moscow and Chelyabinsk are based on the centers of gravity for Company X's sales. The results for the different alternatives are described next.

7.1.2. Results of the different alternatives

Next, summative visual presentations of the alternatives are given, each in their own figures. Each figure shows a conceptual map of the alternative. In the map, distribution centers and production locations are marked with red circles. Blue arrows entering them indicate inbound transportation and red arrows leaving them symbolize outbound transportation. Pictograms show the transportation mode in question, namely sea or road transportation. Railroads are considered a possibility, but they are not shown separately as to keep the map simple.

Under each map, some key information of the alternatives is given. Those are the number and location of the distribution centers, average inbound distance and average DC-distributor distance. Lastly in the figures, the positives and the negatives of each alternative are considered, as is in figure 7.1., which is the first figure in the series and summarizes the base case.



Number of DCs: 2
Locations: Yanino and Tatarstan
In-Russia transportation: road
Average inbound distance: 0km
Average DC-distributor distance: 1280km

Positives:
+ Yanino exists already, Tatarstan will exist in any case
+ Tatarstan location favorable in light of demographic data
+ No inbound transportation within Russia
+ Production driven alternative: "immune" to sales fluctuation
+ Little handling of products

Negatives:
- Two DCs inconvenient for distributors
- Two DCs expensive for Company X
- No Moscow DC
- Distances to eastern distributors
- Transportation cost to and from Tatarstan

Figure 7.1. A summary of the base case (map base from Wikimedia 2007)

In the base case, a commodity distribution center is situated near the Tatarstan plant and a distribution center for imported products is at its current location in Saint Petersburg. As the base case is built with Company X's simplicity and convenience in mind, the natural implication is that the distributors still come to collect their products from the distribution centers. Thus the base case is identical to the current situation with the exception that a Tatarstan distribution center exists in addition to the one in Saint Petersburg, and the distributors have to visit both of them if they wish to have access to the full offering of Company X.

Figure 7.2. show a summary of alternative 1, which is based on simplicity for Company X, and it is also simpler to the distributors than the base case.

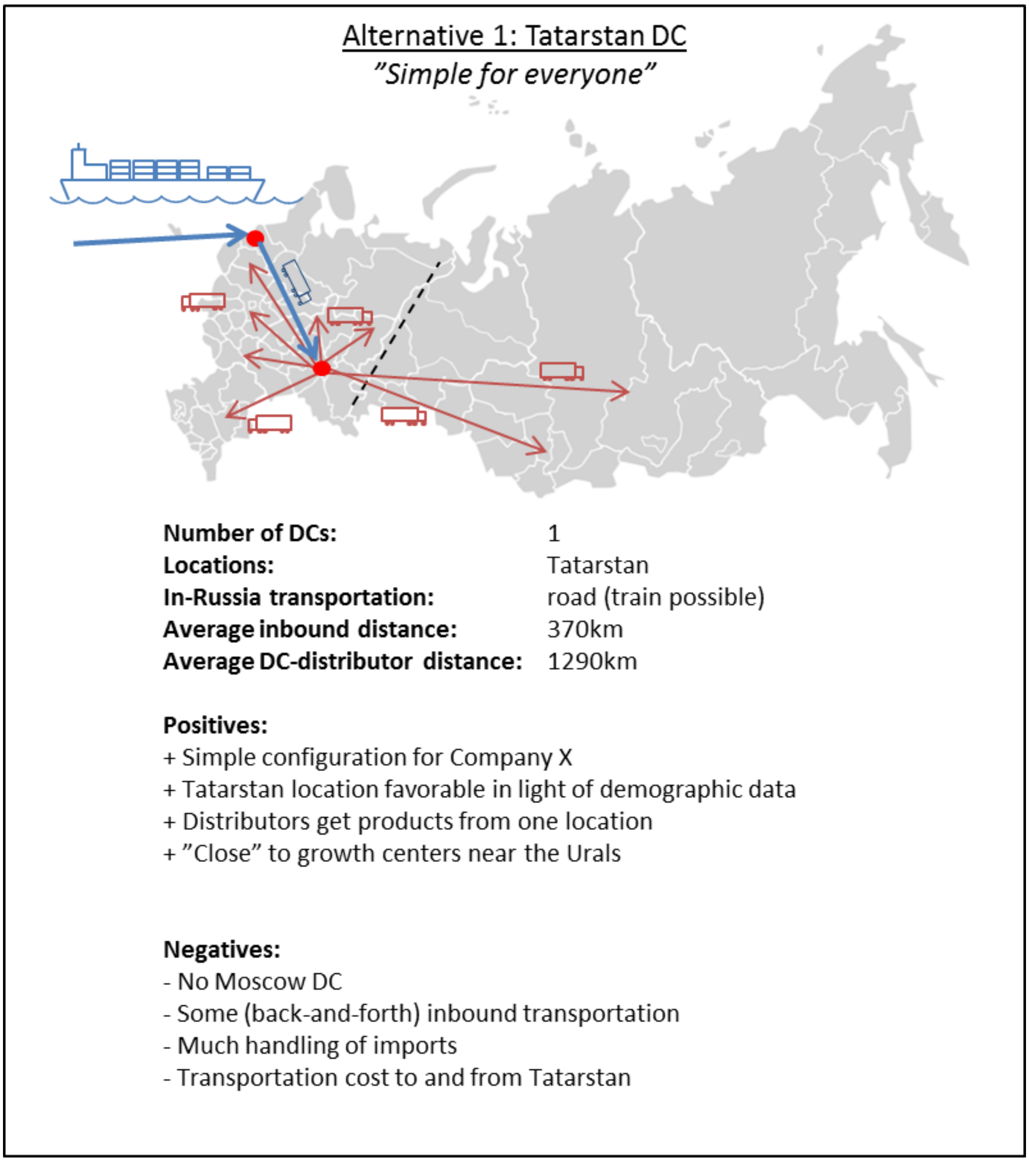


Figure 7.2. A summary of alternative 1 (map base from Wikimedia 2007)

Alternative 1 is similar to the base case with the exception that the only distribution center is situated in Tatarstan, and Company X transports the imported products there from Saint Petersburg. This means more transportation costs for Company X, but the basic configuration is simpler since there is only one distribution center. As was with the base case, this alternative is one with little change compared to current affairs, and distributors coming to collect the products fit the solution well.

Lastly, alternative 2, which is also the proposed alternative, is summarized in figure 7.3.

Number of DCs: 2
Locations: Moscow and Chelyabinsk
In-Russia transportation: road (train possible)
Average inbound distance: 1140km
Average DC-distributor distance: 410km

Positives:
+ Closest to customers
+ A Moscow DC
+ Customers get products from one location
+ Potential to win new business

Negatives:
- Most inbound transportation
- Cost of two DCs
- New locations
- Much handling of all products

Figure 7.3. A summary of alternative 2 (map base from Wikimedia 2007)

Alternative 2 is the most daring alternative with completely new distribution center locations in Moscow and Chelyabinsk and the possibility of delivering the products to distributors. However, it is also the most strategically far-sighted alternative, and it is the one that could yield the highest benefits in light of winning new business and serving clients. Alternative 2 is described in more detail next in the plan of action.

7.2. Plan of action

The proposed alternative is alternative 2 with distribution centers in Moscow and Chelyabinsk. This decision is based on strategically far-sighted, customer-oriented view of the development of Company X's business. As it has been mentioned before, the decision is only as good as its prioritization and basic assumptions, and arguments for choosing other alternatives can be made, too. The base case with distribution centers in

Tatarstan and Yanino is a functional model as well, but the author wants to stress the long-term possibilities that come with the Moscow-and-Chelyabinsk alternative.

In the proposed alternative, both distribution centers are “all-inclusive”, and the Moscow distribution center serves clients west of the Urals and the Chelyabinsk distribution center serves customers east of the Urals – mainly. Some exceptions exist, since Perm, for example, is situated west of the Urals, but it is much closer to Chelyabinsk than Moscow. Thus the conceptual division line is along the Urals, but in reality, the distributors are served by the distribution center that is closer or more convenient.

As the distribution centers carry all products, both distribution centers will get their inventory from the Tatarstan plant and from Saint Petersburg. Imported products will include the more high-end items and the metal grids, whereas the bulky commodity items will come from the Tatarstan plant. This puts the distribution center at an unequal position concerning imported products, since the Moscow distribution center is much closer to Saint Petersburg (780km) than Chelyabinsk (2420km). For local production, the situation is more level, as the Tatarstan plant is roughly as far away from Moscow (1020km) and Chelyabinsk (750km).

The transportation is carried out by trucks, but railroads can be added to perform transportations between manufacturing/import and the distribution centers. The ownership of the transportation is left unresolved; the situation is similar whether or not Company X performs the deliveries to distributors. If not, being near the distributors is a service element. If Company X starts delivering their products, being near distributors cuts down Company X’s transportation costs and lead times.

As for the schedule, the model can be adopted at any time, as it is applicable to the current situation and the post-Tatarstan situation. It is even possible to start the distribution center in Moscow first serving entire Russia from there and then adding the Chelyabinsk distribution center when the time comes.

7.3. Future developments

Some future developments that may and will affect the viability of all of the proposed alternatives and Company X’s operations in general include the following: the development of Russia east of the Urals, moving to rail transportation, bypassing Saint Petersburg, eliminating middlemen, servicing CIS countries through Russia and the development in southern Russia.

The rise of Russia east of the Urals is something that will happen – but its extent is questionable. The Chelyabinsk distribution center is an attempt to answer this development, and it serves two purposes: Firstly, the regions near Chelyabinsk are rich in natural resources, and their development is mostly a matter of development and construction catching up with the GRP generated there. The other aspect is the "other eastern Russia", meaning the regions east of the booming, resource-rich areas. The areas covered are vast and the population sparse and unevenly distributed. The market there is difficult to navigate, but a distribution center at Chelyabinsk would be a step in that direction.

Moving to rail transportation is also something that could affect the operations in Russia. In this thesis, railroads were left open as a possibility for inbound transportation in each alternative, but they were not developed fully. If environmental concerns, for example, prove to be significant or material flows are large and steady enough to support it, railroads can be an excellent means of transportation to suit Company X's inbound transportation – maybe even some of the outbound.

Company X's current operations may change in the future, too. Bringing the imported products to Russia through Saint Petersburg was considered as a prerequisite in this thesis, but it may be bypassed in the future. Especially, if a distribution center is placed in Moscow, transporting the products through Europe by road or railroad can prove to be viable.

Another, larger strategic move is the possible elimination of middlemen – distributors – or at least moving from ex works to delivering the products to distributors and capturing more of the value chain. The Moscow-and-Chelyabinsk alternative 2 is one that would accommodate both of these scenarios well, but if a clear strategic direction were dictated, other alternatives could be devised as well.

Development in southern Russia and the CIS countries there (Armenia, Georgia and Azerbaijan) are also a question that could affect the future of Company X. The CIS countries in Central Asia (Tajikistan, Kyrgyzstan, Uzbekistan and Turkmenistan) are also conveniently situated for a distribution center in Tatarstan or east of the Urals. However, the landmass becomes so vast if "the Stans" are added that the situation deserves more examination than merely mentioning it in this paragraph.

7.4. Suggestions for further research

For Company X, the development of the proposed alternative to an executable plan is the most obvious suggestion for further research. As the Tatarstan plant will be built and a distribution model will be needed, further investigation would be a natural continuation of this thesis. However, as it has been mentioned earlier, the choice of the proposed alternative is not an objectively or unquestionably best alternative – it is the best alternative given the basic assumptions behind it. Closer definition of these assumptions and more iteration in the process will be needed if the research is continued.

Another, somewhat intertwined topic for further research from Company X's viewpoint is the future economic and societal developments in Russia and their effect on Company

X's business there. Other than general Russian developments, the possibilities brought about by rail transportation, land transportation through Europe, deliveries to distributors and direct contacts to end-customers are something that Company X should investigate.

As this thesis suffered from lack of access to confidential data and the postponement on the decision whether or not access would be granted, the results were superficial on some of the parameters. Thus the basic model of assessing distribution alternatives on the criteria mentioned – location optimization, mode of transportation, logistics costs, lead times, risks and sensitivity analysis – is recommendable when there is sufficient access to both data and information from managerial level on what the prioritization of Company X is in the market. The shortcomings of this thesis, however, resulted serendipitously in research that would not have been done had data and information been available from the start. The application of external, demographic data on approximating end-customer data is something that may prove beneficial for Company X, and it has also applications for research in general.

Research in a theoretical, non-Company X specific level could be made on the applicability of secondary, external data to the approximation of the distributions of end-customers or volumes at the "end-nodes" in a supply chain when such primary data is unavailable. The McDonald's example shown earlier was a mere thought experiment, and nothing definitive can be concluded based on it, but it indicated that the distribution of population and actual McDonald's restaurants yield significantly similar results. Thus, if the locations of the McDonald's restaurants (whose sales volumes, however, were ignored in the example) had been unavailable, population data could have been used to approximate the applicability of the distribution alternatives.

Further research could be made also on the applicability of centers of gravity in similar decision making situations. This means applying the centers of gravity to the situating of both distribution centers and, on a higher strategic level, production facilities themselves. As it was discussed in the chapter concerning the theoretical framework of this thesis, researchers tend to dismiss distribution centers and focus on other echelons of the supply chain – mainly the production facilities.

This thesis scraped the surface on distribution models and proposed a solution for Company X to apply to the Russian market. Regardless of the difficulties in the research process, a conceptual solution was devised. The process of developing a full-fledged distribution model has started and gained momentum. Whether or not this movement is continued, directed elsewhere or let screech to a halt and abandoned depends entirely on the company, but this is a beginning.

REFERENCES

Ashayeri, J. & Rongen J. M. J. 1997. Central Distribution in Europe: A Multi-Criteria Approach to location selection. The International Journal of Logistics Management. 81, 1, pp. 97-109.

Association of Interior Specialists 2006. Site guide: Suspended ceilings. [WWW] [accessed on 18.2.2013] Available at: http://www.ais-interiors.org.uk/assets/Uploads/AIS-Site-Guide-for-Suspended-Ceilings.pdf

Ballou, R. H., 2004. Business Logistics/ Supply Chain Management. Fifth edition. Upper Saddle River, New Jersey, Pearson Education, Inc. 780 p.

Ballou, R. H., Rahardja, H. & Sakai, N. 2002. Selected country circuity factors for road travel distance estimation. Transportation Research Part A, 36(9) Weatherhead School of Management, Case Western Reserve University, Cleveland, Ohio. pp. 843-848.

Belova, A. G. & Thompson L. S. 2005. RZD reform makes good progress. Railway Gazette International, 161, 19, pp. 633-636.

Capgemini 2007. Logistics map of Russia. [WWW] [updated on 12.3.2007] [accessed on 21.3.2013] Available at: http://www.capgemini.com/insights-and-resources/by-publication/logistics_map_of_russia/

Cormier, G. 2005. Operational research methods for efficient warehousing. In: Langevin, A. & Riopel, D. (Ed.) Logistics systems: Design and optimization. USA, Springer Science + Business Media, Inc. pp. 93-122.

Daww, R. L. 1995. Reengineer warehousing. Transportation and Distribution 36, l, pp. 98-102.

Encyclopaedia Britannica 2013a. Marketing: Place. [WWW] [accessed on 28.2.2013] Available at: http://global.britannica.com/EBchecked/topic/365730/marketing/27215/Place#ref393975

Encyclopaedia Britannica 2013b. Total factor productivity. [WWW] [accessed on 12.2.2013] Available at: http://global.britannica.com/EBchecked/topic/600411/total-factor-productivity

Encyclopaedia Britannica 2013c. Great circle route. [WWW] [accessed on 11.2.2013] Available at: http://global.britannica.com/EBchecked/topic/243065/great-circle-route

Encyclopaedia Britannica 2013d. Mercator projection. [WWW] [accessed on 11.2.2013] Available at: http://global.britannica.com/EBchecked/topic/375638/Mercator-projection

Finpro 2012. Maaprofiilit: Venäjä. [WWW] [accessed on 12.2.2013] Available at: http://www.finpro.fi/maaprofiilit/venaja

Google Maps 2013. [WWW] [accessed on various dates] Available at: http://maps.google.com

Hadaya, P. & Cassivi L. 2007. The role of joint collaboration planning in a demand-driven supply chain. Industrial Management & Data Systems 107, 7, pp. 954-978.

Hax, A.C. & Candea, D. 1984. Production and Inventory Management. Eaglewood Cliffs, New Jersey, Prentice Hall. 513 p.

Higginson, J. K. & Bookbinder J. H. 2005. Distribution centres in supply chain operations. In: Langevin, A. & Riopel, D. (Ed.) Logistics systems: Design and optimization. USA, Springer Science + Business Media, Inc. pp. 67-91.

International Monetary Fund 2012. Russian Federation: Selected Issues. August 2012. IMF Country Report No. 12/218. International Monetary Fund, Washington, D.C. 57 p. Available at: http://www.imf.org/external/pubs/ft/scr/2012/cr12218.pdf

International Monetary Fund 2013. World Economic Outlook Update: Gradual Upturn in Global Growth During 2013. January 23, 2013. [WWW] [accessed on 20.2.2013] Available at: http://www.imf.org/external/pubs/ft/weo/2013/update/01/index.htm

International Trade Center 2012. Russia's accession to the WTO: Major commitments, porssible implications. 25 p. Available at: http://www.intracen.org/uploadedFiles/Russia%20WTO%20Accession%20English.pdf

Johanson, J. & Vahlne, J.-E. 1977. The internationalization process of the firm – a model of knowledge development and increasing foreign commitments. Journal of International Business Studies 8, 1, pp. 23-32.

Johanson, J. & Vahlne, J.E. 2009. The Uppsala internationalization process model revisited: From liability of foreignness to liability of outsidership. Journal of International Business Studies, 40, 1411-1431.

Kormyshov, E. 2005. Russian Market of Inland Water Transport. ECMT/ENECE/CCNR/DC Workshop, Paris, 22-23 September 2005. Available at: http://www.internationaltransportforum.org/IntOrg/ecmt/waterways/Paris2005/Kormyshov.pdf

Kosonen, R. 2011. Liiketoiminnan turvallisuus Venäjällä ja Kiinassa. Helsinki, Aalto-yliopisto, Kauppakorkeakoulu, Kansainvälisten markkinoiden tutkimuskeskus CEMAT. 100 p.

Kosonen, R., Kettunen, E., Leppänen, S., Penttilä, A, Hietikko, M., Arkko, P. & Saarinen, S. 2012. CEMAT Venäjän talousnäkymät 2/2012. Helsinki, Aalto-yliopisto, Kauppakorkeakoulu, Kansainvälisten markkinoiden tutkimuskeskus CEMAT. 82 p. Available at: http://cemat.aalto.fi/fi/electronic/prospects/russia/venajan_talousnakymat_2_2012.pdf

Kouznetsov, A. 2009. Country conditions in emerging markets and their effects on entry mode decisions of multinational manufacturing enterprises: Evidence from Russia. International Journal of Emerging Markets, 4, 4, pp. 375-388.

Kuznetsov, A. & Kuznetsova O. 2005. Business Culture in Modern Russia: Deterrents and Influences. Problems and Perspectives in Management, 2/2005, pp. 25-32.

Krajewski, L., Malhotra, M. & Ritzman, L. 2013. Operations Management: Processes and Value Chains. Tenth edition. Harlow, England, Pearson Education Limited. 671 p.

Laakkonen, V., Tiusanen, T. & Jumpponen, J. 2005. Venäjälle – mutta minne? Suomalaisyritysten investoinnin sijaintipaikan valintaan vaikuttavat ulkoiset tekijät. NORDI Publication No. 18. Lappeenranta University of Technology. 32 p. Available at: http://157.24.2.217/fi/nordi/publications/publicationslist/2005/Documents/18_Sijaintipaatokset.pdf

Liimatainen, H. 2012. Kuljetukset ja logistiikka osana tuotteiden ympäristövaikutuksia. Tampere University of Technology. Lecture slides for the course TUR-3250.

[WWW] [created on 16.11.2012] [accessed on 12.3.2013] Limited availability at: https://moodle2.tut.fi/pluginfile.php/106884/mod_resource/content/0/luento121116.pdf

Lorentz, H. 2008. Production locations for the internationalizing food industry: case study from Russia. British Food Journal 110, 3, pp. 310-334.

Louhivuori, J. 2006. Russia’s Food Retail Sector from the Point of View of Finnish Food Producers. NORDI Publication No. 26, Lappeenranta University of Technology. 91 p. Available at: http://doria17-kk.lib.helsinki.fi/bitstream/handle/10024/31078/TMP.objres.184.pdf?sequence=1

Luo, Y. 2002. Multinational Enterprises in Emerging Markets. Copenhagen Business School Press. 364 p.

Martin, R. 1999. Transforming Management in Central and Eastern Europe. New York, New York, Oxford University Press. 232 p.

Mattsson, L.-G. & Salmi, A. 2013. Changing role of personal networks during Russian transformation. Journal of Business & Industrial Marketing, 28, 3, pp. 190-200.

Mendes, P. Jr. 2011. Demand Driven Supply Chain: A Structured and Practical Roadmap to Increase Profitability. Springer, Heidelberg. 185 p.

Ministry for Foreign Affairs of Finland 2012. Maatiedosto Venäjä: Talous, elinkeinoelämä ja ulkomaankauppa. [WWW] [updated on 12.11.2012] [accessed on 12.2.2013] Available at: http://formin.finland.fi/public/default.aspx?nodeid=30932&contentlan=1&culture=fi-FI

Ministry of Defence of Finland 2012. Muutosten Venäjä. Helsinki, Ministry of Defence. 111 p. Available at: http://www.defmin.fi/files/2118/muutosten_venaja_nettiin.pdf

Ministry of Transportation and Communications of Finland 2012. Logistiikkaselvitys 2012. Helsinki, Liikenne- ja viestintäministeriön julkaisuja 11/2012. 169 p. Available at: http://www.lvm.fi/c/document_library/get_file?folderId=1986562&name=DLFE-15768.pdf&title=Julkaisuja%2011-2012

OPORA 2011. Предпринимательский климат в России: Индекс ОПОРЫ 2010-2011. 168 p. Available at: http://opora.ru/upload/Reserch/Index_2011_corr_040711_sec.pdf

Pekkarinen, O. 2005. Northwest Russian transport logistics cluster: Finnish perspective. Lappeenranta University of Techology, Northern Dimension Research Centre. 122 p. Available at: http://www.doria.fi/bitstream/handle/10024/31059/TMP.objres.164.pdf?...1

Rautava, J. 2002. The role of oil prices and the real exchange rate in Russia’s economy. Helsinki, Bank of Finland, Institute for Economies in Transition, BOFIT. 23 p.

Rinne, P. 2007. Scenarios for the Russian Construction market. NORDI Publication No. 39, Lappeenranta University of Technology. 38 p.

Rodrigues, A. M., Bowersox, D. J. & Calantone, R. J. 2005. Estimation of global and national logistics expenditures: 2002 data update. Journal of Business Logistics, 26, 2, pp. 1-15.

Roso, V. 2008. Factors influencing implementation of a dry port. International Journal of Physical Distribution & Logistics Management 38, 10, pp. 782-798.

Russian Federation Federal State Statistics Service 2004. Численность населения России, субъектов Российской Федерации в составе федеральных округов, районов, городских поселений, сельских населённых пунктов – районных центров и сельских населённых пунктов с населением 3 тысячи и более человек. [WWW] [retrieved on 3.4.2013] Available at: http://perepis2002.ru/ct/html/TOM_01_04_1.htm

Russian Federation Federal State Statistics Service 2008. Валовой региональный продукт по субъектам Российской Федерации в 1998-2007гг. [WWW] [retrieved on 3.4.2013] Available at: http://www.gks.ru/bgd/free/b01_19/IssWWW.exe/Stg/d000/vrp98-07.htm

Simchi-Levi, D., Kaminsky, P. & Simchi-Levi, E. 2003. Designing & Managing the Supply Chain: Concepts, Strategies & Case Studies. 2nd international edition. New York, New York, McGraw-Hill Higher Education. 354 p.

Smykay, E.W., Bowersox, D.J. & Mossman, F.H. 1961. Physical Distribution Management – Logistics Problems of the Firm. New York, New York, The Macmillan Company. 469 p.

Stevenson, W. J. 2011. Operations Management. Eleventh edition. New York, New York, McGraw-Hill/Irwin. 908 p.

Stoner-Weiss, K. 2000. Foreign direct investment and democratic development in the Russian Provinces: A preliminary analysis. Policy Studies Journal 28, 1, pp. 96-113.

Tuominen, T., Kitaygorodskaya, N. & Helo, P. 2009. Benchmarking Russian and Finnish Food industry supply chains. Benchmarking: An International Journal: 16, 3, pp. 415-431.

UK Trade & Investment 2012. Construction Industry in Russia. [WWW] [created on 5.3.2012] [accessed on 12.2.2013] Available at: http://www.ukti.gov.uk/export/sectors/construction/sectorbriefing/268980.html

UNESCO World Heritage Convention. Brasilia. [WWW] [accessed on 15.4.2013] Available at: http://whc.unesco.org/en/list/445

United Nations Development Program 2011. National Human Development Report for the Russian Federation 2011: Modernization and Human Development. [WWW] [retrieved on 3.4.2013] Available at: http://www.undp.ru/documents/nhdr2011eng.pdf

Wikimedia 2005. File:Northern Hemisphere LamAz.png. [WWW] [created on 25.10.2005] [accessed on 8.3.2013] Available at: http://commons.wikimedia.org/wiki/File:Northern_Hemisphere_LamAz.png

Wikimedia 2007. File:Blank map of Russia-gray.svg. [WWW] [created on 28.12.2007] [accessed on 14.3.2013] Available at: http://commons.wikimedia.org/wiki/File:Blank_map_of_Russia-gray.svg

Woxenius, J., Roso, V. & Lumsden, K. 2004. The Dry Port Concept – Connecting Seaports with their Hinterland by Rail. Journal of Transport Geography 17, 5, pp. 338-345.

Yang, J. & Lee, H. 1997. An AHP decision model for facility location selection. Facilities, 15, 9/10, pp. 241-254.

Confidential sources:

Company X 2012a. Investor presentation from October 2012.

Company X 2012b. Investor presentation from May 2012.

Company X 2012c. Annual report.

Company X 2012d. Corporate brochure.

Company X 2013a. A summary on corporate history from the company's website.

Company X 2013b. Current report.

Company X 2013c. Investor presentation from February 2013.